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No. 78

LOTHAL
A HARAPPAN PORT TOWN
1955-62

VOLUME II

LOTHAL
A HARAPPAN PORT TOWN

73044

1955-62

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By
S. R. RAO

WITH CONTRIBUTIONS BY PROF. S. S. SARKAR, Dr. B. B. LAL, V. K. CHARI, BHOLANATH, G. V. SRINIVASA RAO, K. RAMESH RAO & KRISHNA LAL

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PREFACE

The second volume of the report on the excavations at *Lothal—A Harappan Port Town* was ready in 1966 along with the first volume which was published as Memoir No. 78 of the Archaeological Survey of India in 1979, but owing to circumstances beyond author's control, the publication of the second volume has been delayed. Anyway it is gratifying to find that this volume has now seen the light of the day.

Normally excavation reports are not indexed, but an exception has been made in this case by providing a short index to both the volumes to facilitate reference to important subjects and sites. Appendixes I and II have been added for updating the information on Indus civilization. A list of Harappan and Late Harappan sites has been given in Appendix III.

I am obliged to Prof. S. S. Sarkar, Dr. B. B. Lal, Dr. K. Ramesh Rao and Krishna Lal, Shri Bhola Nath and Shri V. K. Chari for contributing appropriate technical reports.

My thanks are due to Dr. M. S. Nagaraja Rao, Director General, Dr. H. Sarkar, Joint Director General and Shri K. N. Dikshit, Director, Archaeological Survey of India for bringing out the volume. I am particularly grateful to Shri S. R. Varma, Administrative Officer (Publications) who took great pains at every step to expedite the printing of the book. His long experience in getting technical reports printed has improved the quality of the illustrations which would have otherwise suffered owing to the long interval of almost 20 years between the preparation of halftone blocks and actual printing.

I must express my gratitude to Shri T. K. Sen of Naba Mudran (Pvt.) Ltd, Calcutta for full co-operation and excellent printing.

I am obliged to Sarvasri K. M. Srivastava, Suraj Bhan Chaudhary, Udai Vir Singh, T. S. Iyengar, K. D. Tripathi and S. N. Raghunath for assisting me in preparation of technical reports on pottery, metal, shell, bone, ivory and faience objects. My thanks are also due to Sarvasri Lalit Kumar Jain, V. M. Joseph, M. J. Vyas, B. P. Saxena and Jassu Ram for the line drawings and to Sarvasri M. B. Limaye, S. N. Shah, V. M. Date and Pramod Singh for photographs of antiquities.

Bangalore
November 10, 1985

S. R. Rao.

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LOTHAL—A HARAPPAN PORT TOWN

VOL. II

CHAPTER XV

HUMAN SKELETAL REMAINS FROM LOTHAL

By

Prof. S. S. Sarkar, Department of Anthropology, Calcutta University

1. INTRODUCTION

The Lothal skeletal remains were received from Prof. N. K. Bose, Director, Anthropological Survey of India, Indian Museum, Calcutta, for the purpose of the present report on 23rd May, 1961. The field notes, photographs, etc., were received from Sri S. R. Rao, Superintendent, Archaeological Survey of India, Northern Circle, Agra, under whose direction the above site was excavated from 1955 to 1962.

The skeletal remains comprised 19 skeletons, of which no. 12 could not be traced at the Department of the Anthropological Survey. The present report is, therefore, based upon 18 skeletons. They were excavated during the years 1958-60 from a cemetery which was discovered in 1958. All of them did not seem to be true burials. There were two instances of joint burials (nos. 2 & 3, and 8 & 9). Nos. 13 and 14, though represented by bones of two individuals and mentioned in the field notes as a joint burial were not probably a true burial[1]. The same appeared to be the case with skeleton no. 7. In the case of skeleton nos. 1, 4, 7 and 19 there were no traces of any skull. Skeleton nos 1, 5, 16 and 19 are meagrely represented by the various parts of the body. A true burial is evident in the case of skeleton nos. 2, 3, 6, 8-12 and in the case of nos. 15, 17 and 18 as judged from the photographs of the pencil sketches. They were found with the head to the north and the face directed eastward except in the case of skeleton nos. 12 and 18 which had their head to the west. The joint burials were said to have been removed from a ower level than the other skeletons. The stratigraphic data, where available, are given with each skeleton in Chapter Vol. I.

2. CONDITION OF THE BONES

The bones were extremely fragile and in some cases they were of powdery nature. They were lifted along with earth and grit, encased in a solution of venyl acetate, which did not penetrate the bone itself but left a rubbery coat upon it, as a result of which, in cases, where the whole hand or the whole foot or the whole vertebral column had been removed, the adherent earth highly charged with saltpetre had burst out (pl. CXXIX) from inside reducing the bones to powders. The same had been the case with the epiphases of the long bones, wherein the venyl acetate solution did not penetrate the spongy tissues. The majority of the bones, excepting some crania, did not receive any attention since their removal from the field. Even on them too, the gummy coating of venyl acetate hindered the study of the cranial sutures and the formania[2]. (Pl. CXXX A-B)

[1]They were true burials as indicated by grave pit-lines. The skulls in the case of 1,4,7 and 19 were missing due to agricultural operations and erosion—S. R. Rao.

[2]For treatment of bones on site see field notes by Gupta Chapter Cemetary (from Vol. I) — S. R. Rao.

3. THE SKELETONS

A. SKL. 1 (Adult, male ?) SRG 8, B 1, (pl. CXCVI A).

This skeleton was found 1 ft. below surface level from layer 2, which comprised hard clay and *kankar,* dark in colour. The head of the skeleton was towards the north, but the skull was missing. No photograph was available but a photo-print of the sketch shows its close association with the joint burial of skeleton nos 2 and 3.

The bones representing the skeleton are comparatively small. No skull or mandible was found as also the lower part of the body, the latter being represented only by two fragments of right femur. The following measurements of the femur were possible.

Prox. Dorso—ventral diam.	25 mm
Prox. Medio—lateral diam.	36 mm
Med. Dorso—ventral diam.	31 mm
Med. Medio—lateral diam.	29 mm
Platymeric index	69.44 mm
Pilastric index	106.82
Circumference of the shaft	93

B. SKL. 2 & 3 (ADULT MALE AND YOUNG ADULT) SRG, 8, B 1 (pl. CXVII).

This joint burial was found in a grave-pit 7 ft. × 3 ft., from layer 3, which consisted of clay and *kankar,* whitish in colour. The skulls of this joint burial were to the north and the face turned to the south-west. It has been stated in the field notes that, "The left half of the skeleton no. 2 is missing probably due to disturbance caused by grave-pit of skeleton. 11".

Of the two skeletons in the present joint burial skeleton no. 2 appears to belong to an adult male about 20 years of age, whereas skeleton no. 3 belongs to an young adult. The difference in the age of the two skeletons could be judged by the dentition and by the robusticity of the different parts of the skeletons. This will be evident from the following measurements of the lower limbs. Both the skeletons are however fairly represented by all the bones of the body.

	Skl. 2			Skl. 3		
	Femur		Tibia	Eemut		Tibia
	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.
Prox. Dorso-ventral diam	24			18	19	
,, Medio-lateral diam	28			25	22	—
Platymaric index	85.72			78.26	86.36	—
Med. Dorso-vental diam	—	21	24.5	—	—	21
,, Medio-lateral diam	—	20	21	—	—	17
Platycnemic index	-95.24	85.71		—	—	80-95

C. SKL. 4 (ADULT, MALE ?) SRG 8, B 1 (pl. CXVI B).

This fragmentary skeleton was found from layer 3, similar to that of the joint burial, described before, with the head towards the north. The skeleton was lain on its back. As will be evident from the appendix the skeleton is represented only by the right upper limb and some ribs. The bones appear to belong to a very robust male individual.

D. SKL. 5 (ADULT) SRG 8, D 1, (pl. CXVIII A).

This skeleton was found at a depth of 3 ins. below surface with the head towards the north. The skeleton is represented by the upper part of the body, the lower part being represented by a fragment of femur only. The skull is represented by a fragment of the vault. The age of the skeleton has been mentioned in the field notes as "an individual below 12 years of age" but it appears to belong to an adult from all the available bones and from the dentition.

E. SKL. 6 (ADULT, MALE) SRG 8, D 1, (pl. CXIX).

This skeleton was found at a depth of 4 ft. 5 ins. below surface from a grave-pit 7 ft. 2 ft. 4 ins. × 1 ft 2 ins. The body was lain on its spine with the head to the north facing east.

The skeleton is well represented by all the bones of the body. The vault of the skull was found in bits of broken bones but the base of the crania and the facial portion were preserved. Among the skeletal remains, bones of a slender built individual, as seen in clavicle, radius, ulna and fibula (pl. CXXV B) were found. There was also a fragment of the upper end of radius of an infant. The left side of the skeleton is intact. Only the right forearm, the other bones below it and the right femur are missing.

The left tibia shows at its lower end chopping marks of a sharp weapon (pl. CXIX).

F. SKL. 7 (ADULT, MALE) SRG 8, D 1, (pl. CXVIII B).

This skeleton was found at a depth of 1 ft. 3 ins. below layer 2. There was no regular arrangement of the bones nor any proper orientation of the body. No regular grave-pit was found. No skull was found but a damaged mandible was present.

The skeleton is well represented by almost all the bones excepting the vertebras and the ribs. It belongs to an extremely robust individual. The stature, calculated from the right tibia, according to the Lee and Pearson formula, comes up to 1856.20 mm (6 ft. 2 ins). which falls in the very tall group.

G. SKL. 8 & 9 (ADULT, MALES) SRG 2, W 28, (pl. CXX A).

This joint burial was found from a rectangular grave-pit measuring 5 ft. × 3 ft. lined internally with mud bricks of the size, 15 ins. × 9 ins. × 3 ins. from layer 3 (hard clay and whitish *kankar*). The heads of the skeletons were to the north and the faces tilted eastwards. Skl. no. 8 appears to be lying on its spine while skl. no. 9 buried towards the left of the former, was on its left side. The lower limb bones below the femur of both the skeletons were missing.

Both the skeletons have, however, their crania somewhat well preserved. Their close similarity in measurements (Table IV) and also in the craniogram (fig. 37B) appear to indicate a familial resemblance between the two individuals. No. 8 appears to be older

in age than no. 9, as seen in eruption of the III molar on the mandible and also in the relative robusticity of the limb bones.

H. SKL. 10 (ADULT, MALE) SRG 8, B 2, (pl. CXXB).

This skeleton was found from a grave pit, measuring 7′ 5″ × 2′ 9″ × 1′ 5″, with the head towards the north and the face to the east from layer 2 (hard clay and darkish *kankar*).

The skeleton is fairly well represented by different bones of the body.

The individual appears to be 1652 mm (5 ft. 6 ins.) in stature as calculated from the complete left humerus (Table IV) and thus falls within the tall category. His robusticity will be evident from the measurements of the femora (Table V).

I. SKL. 11 (ADULT, MALE) SRG, 8, B 1, (pl. CXVII).

This skeleton was found from a grave pit measuring 8′ 6″ × 2′ 8″, which is said to have been dug "below the cervical and thoracic region of skeleton No. 1". The body was on its spine, with the head towards the north and the face tilted east. The joint burial comprising skeleton nos. 2 and 3 was found to the west of this burial, which, as appears from the photographs, was on a slightly higher level than the present skeleton. Skeleton no. 1 was found at a depth of 1 ft. from the surface.

The skeleton is well represented by all the bones. The individual appears to be very tall with a stature of 1800.6 mm (6 ft.). as judged from the height of the femur and tibia taken together. Their measurements are given in Tables 5 and 6. Its robusticity appears to be similar to that of skl. no. 6.

J. SKL. 12 SRG 8, B 2, (pl. CXXI A).

This skeleton was found at a depth of 8 ins. below surface with the head towards the west. No proper burial pit was found. The skeleton, as mentioned in the field notes, appears to have been associated with the remains of the mandible of another person.

No bones of this skeleton were received by the present author.

K. SKLs. 13 AND 14 (ADULT, MALES) SRG 2, Y 28, (pl. CXXI B).

This burial was found from a depth of 1 ft. below surface but this joint (?) burial does not appear to be similar to those of skls. nos. 2 and 3, and skls. nos. 8 and 9. Skl. no. 14 had its head to the north but it appears to have been detached from the vertebral column. The body appears to have been buried or thrown off in a huddled-up manner in order to explain the presence of the femur and the pelvis by the thoracic region[1].

Both the skeletons are not well represented by the different bones. Skl. no. 13 appears to be younger in age than skl. no. 14 as seen in the eruption of the third molar, and the relative robusticity of different limb bones. Both appear to be slender built persons, as will be evident from the following measurements of the femora

	Skl. 13	Skl. 14	
	Lt.	Rt.	Lt.
Prox. Dorso-ventral diameter	31	27	26.5
,, Medio-lateral ,,	32	27	28.8
Platymeric index ..	96.88	100	94.64

[1]The disturbed condition of the burial is due to agricultural operations and erosion—S.R. Rao

L. SKL. 15 SRG 8, E 2, (pl. CXXII A).

This skeleton is fairly well represented by the different bones, of the skeleton. It appears to belong to a child about 9—10 years of age. The skull appears to be pathological in nature (hydrocephalic?). The cranial length of 201? mm is too large for a child of the above age. The skull shows a square trepanned hole on its right temporal surface.

M. SKL. 16 SRG 8, E 2, (pl. CXXI B).

This skeleton is rather meagrely represented by different bones of the body. There are also remains of a second individual as judged by the nearly complete pelvis, a femur and a tibia all belonging to the left side (pl. CCXXIV). One of the left femur appears to show at its distal end signs of malunion resulting from a healed fracture (fig. 33). The stature of this individual as estimated from the femur appears to be 1677.80 mm (5′ 7″).

N. SKL. 17 (ADULT, MALE) SRG 8, C 2, (pl. CXXIII).

This skeleton is fairly well represented by all the bones excepting those of the right upper limb. It appears from a photoprint of the drawing that the skeleton was lain on its spine fully extended, the head being towards the north. It was associated with a group of burial pottery.

O. SKL. 18 (ADULT, MALE) SRG 26, (pl. CXXIV).

This was also an extended burial with the head towards the north and the body on spine. The skeleton is well represented by all the bones of the body.

The stature of the individual, as obtained from the length of the humerus, according to Lee and Pearson formula, appears to be 1620. 50 mm (5 ft. 5 ins.), thereby falling within the below medium category.

P. SKL 19 (ADULT, MALE) SRG 8, C 3.

This skeleton is represented only by the bones of the two feet.

The bones are very robust and appear to belong to a male, as judged from the length and robusticity of the metatarsal. The metatarsal[1] of the left foot is 76 mm long compared with 67 mm. of the same bone of skl. no. 18.

Besides the above skeletons 6 grave-pits, numbered A—D were also found, none of which, excepting grave-pit C showed any human remains. Grave-pit C yielded fragments of a cranium which was "not lifted" as it was thought to be "useless for study purposes".

The position of the grave-pits in relation to the above skeletons is known only in the case of grave-pit A which was found to the north of skeleton no. 5. All the grave-pits however showed remains of pottery.

[1]This is found to be due to ploughing.

4. POPULATION

The total population, represented by the Lothal skeletal remains described before, appears to comprise 21 individuals. All the skeletons were singly represented excepting those of Skl. nos. 6 and 16. The former has yielded remains of three individuals, one of which is an adult male, well represented by the different bones of the body, the second by four bones of an infant. Skl. no. 16 shows the presence of two adult males. The total population is as follows :—

Adult male	— 15	
,, ,,	— 1	
Adult (Sex ?)	— 1	(Skl. no. 5)
Young adult	— 2	(Skl. Nos. 3 and 6)
Child (9-10 years)	— 1	(Skl. no. 15)
Infant	— 1	
	21	

There is thus an overwhelming majority of males in the population.

Compared with the total number of individuals the number of crania, represented in whole or in parts, is only 14. Skl. no. 7 showed however the presence of a mandible besides other bones of the body. If Skl. no. 19 which is known by the bones of the two feet only, is excluded there are three headless skeletons (nos. 1, 4 and 7) in the sample.

5. THE CRANIA

A. SK. 2 (JOINT BURIAL WITH SKL. 3) SRG 8, B 1, (pls. CXXXI A to CXXXII C.).

Skull comminuted all over due to pressure from above but the endo-cranial encrustation has adhered the cranial bones into shape; a large part of the vault of the skull comprising the major part of the frontal, left parietal and also parts of the left orbit and zygoma missing, the distorted shape has caused an angular bulge towards the left parietal-occipital side while fragments of bones are raised upwards on the right parietal surface, nasal bone missing, base of the skull intact.

Adult, male, dolichocranial (73.54 ?), Cranial capacity—1312 c.c.

Norma verticalis

Long oval in shape, broadest at the parietal tuberosities, the posterior part of the sagittal, and the lambdoial suture present, markedly prognathous partly due to the distortion of the alveolar border.

Norma Lateralis (Right)

Although the vault is missing, it appears to be medium vaulted, forehead missing; left supraorbital ridge well developed; supra-mastoidal crest marked; mastoids medium; occipital region rounded in appearance; pre-auricular and post-auricular developments nearly equal.

Left side does not show any peculiarity from the above, left zygoma missing.

Norma occipitalis

The occipital surface is rounded in appearance, although it has undergone some distortion and shows an angular projection due to distortion mentioned before on the left side.

Norma facialis

Forehead, upper part of the right orbit, left orbit, nasal bone and left zygoma missing; on the whole, the facial appearance discernible; medium breadth and height; glabella and nasion missing; malar prominent and well developed; base of the nose appears to be broad; appears to be platyrrhine; orbits quadrilateral in shape.

Norma basalis

The basal side is better preserved than the other parts; palate more or less U-shaped though the region at the incisors is somewhat distorted, all teeth present excepting the left lateral incisor and the canine; the two III molars are just appearing, being at a much lower level than the other teeth; none of the teeth excepting the two I molars show any significant signs of the wear; glenoid fossa, complete on the right side, appears to be very deep; muscle impressions at the nuchal region not marked. Rt. lateral incisor and canine, missing in the skull were found along with skeletal remains.

The skull appears to belong to a young man about 20 years old.

Mandible

Fairly well preserved, but comminuted like the skull; dentition complete but very brittle; parabolic in outline; left III molar situated at a lower level than its right counterpart and other teeth; only I molar shows significant signs of wear; left condyle; right coronoid and the gonial angles missing; appears to be rather heavily built.

B. SK. 3 (JOINT BURIAL WITH SKL. 2) (pls. CXXXII D—CXXXIII A).

Skull represented by the skull cap badly compressed laterally; whole of facial portion missing excepting two fragments of maxilla with some teeth; base and a large part of the occipital missing.

No measurements were possible.

The skull cap appears to be of an young adult.

Norma verticalis

Long, oval in shape, all sutures not clearly discernible; cranial bones rather thin.

Norma lateralis

Vault medium; right mastoid preserved, mediumly developed.

Norma facialis

Represented by right maxilla, zygoma and base of the orbit and left fragment of the upper palate.

Mandible

Mandible fractured, shape fairly well preserved; left incisors and canine missing, molars very brittle, third molars on much lower level than the other teeth; left coronoid and condyle missing.

C. SK. 5 SRG 8, D 1,

Adult skull represented by a portion of the right parietal and occipital; shape not discernible.
No measurements or description are possible.

Mandible

Badly fractured and distorted; both ramii broken; teeth present on right; 2 premolars and 2 molars on left, canine, first premolar and 2 molars.

D. SK. 6 SRG 8, D 1, (pls. CXXXIII B—CXXXIV A).

Skull found in bits of broken bones, only the facial portion and the cranial base preserved, right orbit missing.
Adult, male, no measurements were possible.

Norma facialis

Right orbit missing, left nearly rounded in shape; nasal bone straight—lower border of nasal opening oxycraspedote; slight alveolar prognathism.

Norma basalis

Clenoid fossa deep; left styloid prominent; palate medium, U-shaped and very deep; all teeth present in situ show signs of much wear, dentine exposed on all teeth excepting on the M_2 and M_3:

Mandible

Mandible found in two fragments, shape distorted, mediumly built; all teeth present in situ excepting the left lateral incisor teeth much worn out; left canine shows signs of caries; left condyle well preserved, right missing; left coronoid missing.

E. SK. 7 (MANDIBLE) (ADULT) SRG 8, D 1, (pls. CXXXIV A-B).

This mandible was found in several fragments but could be fairly reconstructed without the right horizontal ramus. Only seven teeth are present showing the two premolars on either side, the I and II molars on the left, and the II molar only on the right. The I Rt. molar appears to have been broken; only a small fragment is sticking out at the level of other teeth.
The teeth show considerable wear particularly at the labial margines, and in the majority of the cases the dentine is exposed. The mandible on the whole appears to be sturdy-built. The dental arcade is parabolic in outline. There are gaps with depression on the alveolar margin for the III molar on either side but no teeth could be seen.

F.SK. 8 (JOINT BURIAL WITH SKL. 9) SRG 2, W 26, (pls. CXXXIV C—CXXXV D).

Skull comminuted due to pressure from above, held into shape by the endo-cranial encrustation of the soil; shape well preserved; a small portion of frontal, left parietal and a greater part of the right occipital including the whole of foremen magnum missing, the skull shows the impact of a force or weight along an oblique plane which runs along the left side of the vertex and then along the right occipital margin.

Adult, male mesocranial (76.72 ?)
Hypereuryprospoic (79.41), Hypereuryene (42.65 ?)
Cranial capacity 1303 c.c.

Norma verticalis

Long oval in shape, broadest along the parietal tuberosities, sagittal and coronal sutures open; lambdoidal suture fused, marked alveolar prognathism; parietal eminence traceable.

Norma lateralis

Vault medium but slightly distorted; forehead slightly receding: supraorbital ridge medium and continuous; mastoids broken; but appears to be rather weakly developed.

Norma occipitalis

Pentagonal in outline; a rounded bulging occiput; lambdoidal suture open but full of soil incrustations; muscular impressions rather weak.

Norma facialis

Face medium; left side slightly distorted, medium breadth and height; glabella prominent; nose concave, broad and depressed at the root; nasal border oxycraspedote; malar prominent; well developed; forehead medium; supraorbital ridges medium, orbits quadrilateral, left orbit on a slightly lower level than the right probably due to distortion, alveolar prognathism present.

Norma basalis

Palate U shaped, all teeth present but body of right II incisor broken, roots visible, left incisors absent; some teeth are out of the sockets; both the III molars are on much lower level than the rest; teeth not much worn out; glenoid fossa deep, a greater part of the nuchal region is missing, muscle impressions rather weak.

The skull appears to belong to a young man at the prime of life.

Mandible

Well preserved, body contains large number of cracks as in the cranium; dentition complete, dental arcade U shaped; slight signs of wear on teeth; left ascending ramus broken at the gonial angle; right condyle and left coronoid broken; genial tubercles prominent.

G. SK. 9 (JOINT BURIAL WITH SKL. 8) SRG 2, W 26, (pls. CXXXVI A—CXXXVII C).

Skull characterized by linear fractures along the left side but the shape fairly well preserved, slightly distorted at the left parieto-occipital surface; a portion of the cranial base at the region of the left occipital condyle is missing.

Adult, male, Mesocranial (76.29 ?) Mesene (51.66), Mesoprosopic (85.94), (57.47 ?) Cranial capacity 1408 c.c.

Norma verticalis

Long oval in shape, broadest along the parietal tuberosities; alveolar prognathism marked; all sutures open.

Norma lateralis

Vault medium, a keel along frontal bone marked upto the bregma; forehead retreating; supraorbital ridge medium; supramastoidal crest mediumly developed; mastoids broken at the tips, rather weakly developed, mastoidal groove deep; post-auricular region greater than pre-auricular.

Left side similar to the right.

Norma occipitalis

Pentagonal in shape, rounded bulging occiput; left offipital region slightly distorted; nuchal lines marked; muscular impressions moderately developed.

Norma facialis

Face medium, left side slightly distorted, medium in height and breadth; glabella and supraorbital ridges prominent; nose concave; broad inter-orbital region, lower border of nasal aperture oxycraspedote; forehead sloping: orbits quadrilateral; alveolar prognathism prominent.

Norma basalis

Palate U shaped; dentition complete, all teeth present, well preserved, signs of wear slight, both III molars below the alveolar margin and on a markedly lower level than the other teeth; glenoid fossae broad and deep; foramen magnum broken.

The skull appears to belong to a young man at the prime of youth.

Mandible

Well preserved, body contains large number of cracks as in the cranium; dentition complete; teeth well preserved with slight signs of wear; roots of some teeth visible; both III molars almost below the alveolar margin and on a much lower level than the others; gonial angles incomplete; dental arcade U-shaped; left condyle broken along the head.

H. SK. 10 SRG 8, B 2, (pls. CXXXVIII A—CXXXIX C).

Skull found in a badly broken condition in which the right half of the skull had partly gone inside the left along the middle of the skull as a result of which the forehead

is split into two, almost in line with the sagittal suture. The few measurements which were possible at this stage are as follows ;

(i) Maximum cranial length — 212 mm
(ii) „ „ breadth — 141 mm
(iii) Last frontal breadth — 99 mm
(iv) Bimalar „ — 102 mm

The left side could be fairly restored which gave a length of 211 mm; the right side however could not be joined to the left since the union at the sagittal suture was not sufficient to hold the parietal and occipital fragments.

Male, Adult, Hyperdolichocranial (66.51 ?)
Hyperchamerrhine (66.22 ?)

Norma verticalis

Very long; marked parietal tuberosities, occiput rounded; cranial bones very thick.

Norma lateralis (left)

Long, high vaulted; mastoid very prominent; supramastoidal crest marked; zygoma missing; forehead high; nasal bone prominent; alveolar prognathism medium; bulging occiput, pre-auricular and post-auricular regions almost equal.

Norma occipitalis

Nothing discernible excepting the rounded nature of the occiput; bones very thick.

Norma facialis

Part of the right orbit missing; forehead appears to be straight; left supraorbital ridge developed; nasion deep; orbit rectangular; pyriform aperture of the nose broken; incisors broken, bent inwards and the roots exposed; malar prominent.

Norma basalis

Base of the skull fairly intact, as already mentioned the right half of the skull having partly gone inside the left; the foramen magnum appears to be long oval in shape; muscular impressions on the occiputal well marked; glenoid fossa deep and broad; palate horse-shoe shaped and deep but distorted; all teeth present excepting the left II molar and the right II and III molars; wear very much marked on all teeth including the III molars.

Mandible

Mandible found in two fragments, massive, very much damaged; right horizontal ramus missing; all teeth present excepting the left canine; very much worn out including the III molars; incisors comparatively smaller in size specially the upper ones.

I. SK. 11 SRG 8, B 1, (pls. CXL A—CXLI C).

Skull comminuted all over due to pressure from above, shape fairly well preserved; markedly distorted at the left parieto-occipital and facial surface; major portion of the

cranial base along with the occipital foramen missing; a small portion of temporal on either side along the post-orbital constrictions and the inner orbital walls missing, zygomas broken.

Adult male, dolichocranial (73.89), Hyperleptene (63.55 ?), Leptorrhine (44.0 ?).

Norma verticalis

Long oval in shape, broadest along the parietal eminences; all sutures open.

Norma lateralis

Vault medium, forehead retreating, supraorbital ridge prominent; supramastoidal crest mediumly developed; mastoids prominent, broken at the tip; mastoidal groove deep; post-auricular region greater than the pre-auricular.

Left side similar to the right.

Norma occipitalis

Pentagonal in shape, rounded; bulging occiput; left occipital region distorted; muscular impressions weakly developed; a large wormian bone on the left side of lambda.

Norma facialis

Face well preserved, glabella, supraorbital ridge prominent; nose concave; broad inter-orbital region, lower border of nasal aperture oxycraspedote; forehead retreating.

Norma basalis

Palate U shaped; all teeth present excepting left III molar, right III molar on a slightly lower level than the other; teeth show signs of wear; glenoid fossae deep.

The skull appears to belong to a young man.

Mandible

Nearly complete with all teeth *in situ*. III molars absent on either side. Right condyle present in a fragment, left missing.

J. SK. 13 SRG 2, X 26. (pls. CXLII A—D).

Only the facil portion with a part of the frontal bone was found; the left orbit is complete to certain extent; all teeth very much worn out.

Adult, male.

Norma facialis

Face appears to be medium in breadth and height; orbit nearly rounded; slight alveolar prognathism; only the palate with teeth is present; I molars appear to be slightly worn out in comparison with the other teeth; left third molar absent; palate appears to be deep; distorted and U-shaped.

Mandible

Mandible fairly well preserved, both the horizontal ramii missing; all teeth present excepting right III molar which is just visible at the alveolar margin, two left premolars and the lateral incisor missing, lower incisors appear to be smaller in size (almost similar to SRG 8, B 2, Skl. 10 mandible) than the upper incisors, left III molar shows comparatively lesser signs of wear than the other teeth.

No measurements were possible.

K. SK. 14 SRG 2. X 24. (pls. CXLIII A—CXLIV C).

Skull comminuted all over due to superincumbent pressure, shape fairly well preserved; a large part of left frontal, a portion of left parietal, right temporal, zygoma and a large part of basi-cranial along with the foramen magnum missing.

Adult, appears to be male, Hyperbrachycranial ? (91.86 ?), Hypereuryene (44.92 ?) Hyperchamaerrhine (67.44 ?).

Norma verticalis

Broad oval in shape, broadest at the parietal tuberosities; marked alveolar prognathism; sagittal and lambdoidal sutures open; occipital region remarkably high and straight; only a slight curvature noticeable.

Norma laterials (right)

High vaulted skull; forehead straight; supraorbital ridge perceptible; mastoids broken; occipital region markedly high and straight with a slight curvature below.

Left side does not show any peculiarity from the above.

Norma occipitalis

Broad and flat in shape, occipital bone shows slight bulge; two interparietal bones present on the left parietal above the lambdoidal suture; inion prominent; muscular impressions rather weak.

Norma facialis

Forehead straight; face very broad and high; malar prominant; marked alveolar prognathism inter-orbital region broad, lower border of nasal aperture oxycraspedote, orbits quadrilateral, incisors broken at the root but attached to the jaw.

Norma basalis

Greater part of the base along with the foremen magnum missing; palate deep, U shaped; all teeth present, except the right I premolar and the II and III molars and the left II molar, show signs of wear with dentine exposed, left III molar and a canine very brittle.

Mandible

Well preserved, condyles present, sigmoid notch medium dentition complete; parabolic in outline, teeth show signs of wear.

L. SK. 15 SRG 8. E 2. (Pls. CXLV A—CXLVI C).

Skull comminuted all over due to pressure from above, occipital bone completely flattened, resulting into parietal plattening of the vault; left temporal present as a separate fragment, right parietal shows a trepanned hole, square in shape.

Child, 9 to 10 yrs. old, Mesocranial (75.62 ?)

Norma verticalis

Markedly broad oval in shape; vault flattened; marked alveolar prognathism; all sutures open.

Norma lateralis (right)

Vault medium in height; forehead slightly retreating, marked alveolar prognathism, mastoid missing, supramastoidal crest weakly developed, occiput slightly bulging; an almost square trepanned hole (area of the trepanned hole-superior margin-20 mm. inferior margin-31 mm) little below the parietal tuberosity; pre-auricular region smaller than the post-auricular.

On the left side a large part of fronto-temporal is broken.

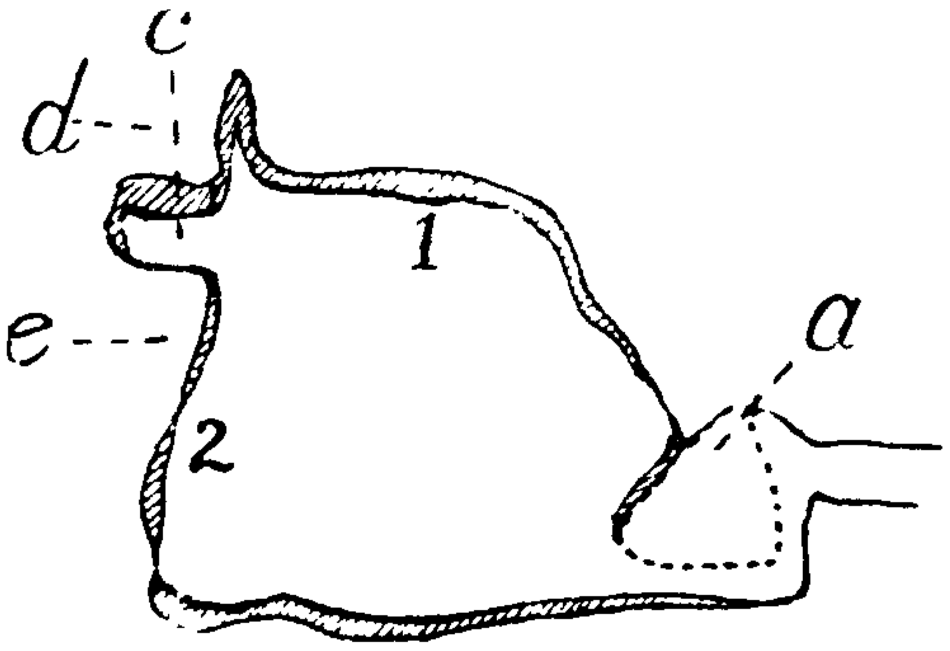

FIG. 37A. *Outline of trepanned area of skull 15.*

Norma occipitalis

Occipital bone undergone marked flattening, fractured into five large fragments.

Norma facialis

Face medium, right facial portion slightly distorted; forehead slightly retreating; supraorbital ridges weakly developed; nasal bone broken; orbits quadrilateral; right permanent canine exposed above the mazillary border.

Norma basalis

Palate U-shaped, shallow; right flenoid fossa shallow; dentition shows permanent I molars and four incisors, cutting edge of incisors serrated, milk molars I and II and the canines present; II molars can be seen below the alveo'ar margin.

Mandible

Shape well preserved, mediumly built; dental arcade U shaped; milk canines and molars I and II present, permanent I molars and four incisors present, cutting edge of incisors present, cutting serrated, second permanent molars below the alveolar margin.

This cranium was sent to Prof. S. K. Basu, M.Sc., M.B., Ph.D., late Prof. of Anatomy, Nilratan Sircar Medical College and now a Lecturer in Physical Anthropology, Department of Anthropology, Calcutta University for his observation. His observation is quoted below :

"The specimen (SRG 8, E 2. Skl. no. 15) shows the skull of a child about 9-10 years old, as judged from the eruption of the I permanent molar, the II permanent molar being just visible. 6 milk teeth (2 molars, 1 canine on each side of each jaw) are also present. The skull looks comminuted all over due to pressure from above. It has, as a result, undergone elongation antero-posteriorly, complete horizontal flattening of the occipital bone and displacement of the parietal posteriorly. The frontal and the facial regions appear to have escaped the compression and more or less retained their natural shape.

The right parietal shows a deficiency anteriorly at the anterior and lower quadrant almost midway between the parietal eminence and the squamose-parietal suture. The dimensions of the deficiency are as follows (fig. 33).

(i) Superior margin, horizontal at its posterior part, concave downards at the anterior part ... 20 mm
(ii) Inferior margin horizontal ... 31 mm

The horizontal parts of the above margins are almost parallel to each other. The anterior margin, jagged and concave backwards, shows a maximum height of 25 mm. The posterior margin is almost vertical and measures 28 mm. There is a notch (7 mm. ×2 mm) at postero-superior corner of the deficiency.

Description of the margins

The surface of the bone, close to the posterior margin and postero-inferior angle, shows shaving of the superficial layer of the bone and parallel scratches, 12 complete and about 5 or 6 incomplete scratches, directed from behind forwards. The direction of the shaving is downwards and forwards. The upper margin shows bevelling downwards and medialwards and slightly backwards. The upper part of the anterior margin is bevelled downwards and backwards and medialwards. The rest shows a curved or angular appearance without any sign of bevelling. The lower border is cut straight inwards at its anterior three-fourths; the posterior one-fourth shows bevelling directed upwards, forwards and medialwards. A slight groove for a branch of the meningeal artery is visible from the inner side of the superior margin of the deficiency. Further examination of the endocranial surface was not possible as the skull was very fragile and the exposure of the endocranial surface was likely to disturb the present shape of the cranium.

Discussion

The angular portion at the lower part of the anterior margin may be due to a missing as well. At *c*, the pieces *d* and *e* appear to have been separated without any loss of material. since the lower border of *d* slopes also in a similar way, the total effect being shown in two disjointed segments *d* and *e* without the segment *c*.

Areas 1 and 2 of the figure definitely show bevelling inwards of the superficial layer of the bone, the bevelled area being 2 mm at its widest part.

The presumption is that bevelling at 1 and 2 is not produced by natural agency. If we presume that the agency is not natural, then we are left with two possibilities, (a) it might have been produced artificially while cleaning the specimen; against this one would suggest that such marks have been produced only at margins 1 and 2 and not along the rest of the margins; (b) it might have been produced by some instrument before the skeleton bearing the specimen was buried. If we presume the latter statement, then in the absence of signs of any bony repair one would conclude that the person did not survive long after the cut was effected or the cut was made post-mortem".

SK. 16 SRG 8. E 2. (pls. CXLVII A—B)

Skull badly compressed laterally but appears to be long-headed (max. length-190 mm. max. breadth-110.5 mm) left facial portion missing as also the whole of cranial base; the right orbit, zygoma and a part of the right maxilla with the canine *in situ* existing.

Superorbital ridge weakly developed; right mastoid, medium; left missing; supra-mastoidal crest mediumly developed; all sutures are not clearly discernible; fusion appears to have begun in all excepting the sagittal along which the cranium has undergone lateral compression; muscular impressions on nichal region weak; right glenoid fossa very deep; cranial bones rather thick, pre-auricular region greater than post-auricular. No mandible was found.

No measurements were possible.

The skull appears to belong to an adult male (?)

N. SK. 17 SRG 8. C 2. (pls. CXLVIII A—CXLIX B).

Skull comminuted all over due to pressure from above, shape fairly well preserved; right facial portion missing, as also a few pieces of bone on the frontal; left zygoma broken; maxilla missing.

Adult, male Brachycranial (81.11 ?);
Chamaecranial (63.33 ?); Tapeinocranial (78.08 ?)

Norma verticalis

Broad oval in shape, broadest at the parietal tuberosities, vault shows slight flattening, all sutures not clearly discernible, appear to be open.

Norma lateralis (right)

Vault medium, undergone slight compression, mastoid mediumly developed, left supraorbital ridge mediumly developed, mastoid medium, supramastoidal crest weakly developed; pre-auricular region smaller than post-auricular.

Norma-occipitals

Pentagonal in shape; lambdoidal suture open, muscular impressions weakly developed.

Norma facialis

Right facial portion missing as also the maxilla; nasal bone distorted; supraorbital ridge on the left mediumly developed, right missing; left malar bone present.

Norma basalis

Fairly well preserved; palate missing; foramen magnum broken; right glenoid fossa deep left broken.

Cranial bones rather thick.

Mandible

Shape well preserved; ramii slenderly built, right II and III molars *in situ,* crown slightly broken; roots and dentine exposed; right condyle broken, left missing; sigmoid notch deep.

O. SK. 18 SRG 26, (pls. CXLIX C—G)

Skull showing linear fractures on the vault and the right parietal surface, shape fairly well preserved; a part of right parietal, left frontal parietal and zygomas missing, basi-cranial portion well preserved.

Adult, male, Brachycranial (84.36), Orthocranial (72.63?), Tapeinocranial (86.09 ?) Euryene (48.90 ?) Hyperchamaerrhine (59.09 ?).

Norma verticalis

Broad oval in shape, broadest along the parietal tuberosities, marked alveolar prognathism, forehead retreating; sagittal and lambdoidal sutures open; cranial bones rather thick.

Norma lateralis (right)

Forehead retreating; supraorbital ridge marked; prominent supramastoidal crest, mastoids prominent; occiput rounded; pre-auricular region greater than post-auricular.

Left side does not show any peculiarity.

Norma occipitalis

Occipital region well preserved, nearly pentagonal in outline; prominent occipital crest, slightly bulging occiput; foramen magnum broken along transverse diameter; muscular impressions well developed.

Norma facialis

Left orbit damaged, retreating forehead; prominent supraorbital ridges, malar prominent; face broad, nasal bridge concave, sunken at the root; lower border of nasal aperture oxycraspedote; orbits quadrilateral, interorbital region broad.

Norma basalis

Palate parabolic in outline, deep and broad; glenoid fossa deep; all teeth present in position, teeth very much worn out excepting III molars; I right molar affected with caries, dentine exposed on molars and premaolrs in small circular cavities.

Mandible

Well preserved; stoutly built, condyles slightly damaged; sigmoid notches deep; ramii broad, teeth show signs of wearing, dentine exposed similar to those of the maxillary molars and premolars-deeply marked on the right I premolar.

TABLE—IV

Measurements of Lothal Crania (in mm)

Number of The Skull	2	8	9	10	11	14	15	17	18
SEX	MALE	MALE	MALE	MALE	MALE	MALE	CHILD	MALE	MALE
1 Max. cranial leng.	189?	189?	194	212?	180?	172?	201?	180?	179
2 Max. cranial br.	139?	145?	148?	141?	133?	158?	152?	146?	151
3 Nasion inion leng.	—	181	179	205?	169?	157	—	164?	163
4 Basilo-breg. ht.	—	—	—	—	—	—	—	114?	130?
5 Least frontal br.	—	104?	102	99?	97?	98	108?	—	—
6 Greatest frontal br.	—	—	121	—	119?	—	—	123?	—
7 Bimastoid br.	102	—	106?	—	81?	—	—	116?	114
8 Bizygomatic br.	133?	136	128	—	—	138?	—	—	137?
9 Nasion basion line	—	—	—	102?	—	—	—	87?	85
10 Prosthion basion"	101	—	—	96?		—	—	—	96
11 Nasion gnathion"	—	108	110	—	—	—	99?	—	—
12 Nasion prosthion"	—	58?	66	72?	68?	62?	58?	—	67
13 Nasal ht.	—	20?	43.5	45?	50?	43?	43?	—	44?
14 Nasal br.	—	—	25?	28?	22?	29?	—	—	26?
15 Inter-orbital br.	—	22	21	27?	22?	24?	28?	—	21?
16 Orbitral br. Right	44	—	40	—		—	—		—
Left	—	41	40	43?	—	39?	41?	—	—
17 Orbital ht.									
Right	34	—	30	—		—			—
Left	—	28	32?	32?	—	33?	33?	—	—
18 Maxillo-alveolar leng.	61?	55?	—	59?	—	54	—	—	59
19 Maxillo-alveolar br.	67	67	65	62?	61?	—	59?	—	70
20 Palatal leng.	57?	51?	—	52?	—	51?	47?	—	—
21 Palatal br	42	41	39	38?	43?	38?	38?	—	46
22 Occipital foramen									
Leng.	38	—	—	—	—	—		38?	30?
Br.	32	—	—	—	—	—		—	—
23 Sagittal cranial arc	—	—	387	—	—	380?	—	370	390
24 Transverse cranial arc	330?	305?	309	—	305?	—	—	300	332
25 Horizontal circumf.	524?	537	538	—	—	525?	—	—	509
26 Bicondylar br.	—	—	146?	—		134	103	—	123
27 Bigonial br.	—	—	96?	—	—	—	81	97	89
28 Ht. of ramus									
Breadth	—	—	56?	—	—	59?	51	—	74(rt.)
(a) Minimum	37	39	36	—	—	32	33	29.5	38
(b) Maximum	—	—	42	—	—	41	37	—	47
29 Symphyseal ht.	29?	34	28	40	—	32	23	—	36
30 Bi-auricular br.	120	118	120	—	104?	—	—	126?	126
31 Outer bi-orbital br.	—	111?	110	—	—	—	—	—	—
32 Inner bi- rbital br.	—	—	98	—	—	—	—	—	—

TABLE—IV Contd.

Number of the Skull	2	8	9	10	11	14	15	17	18
33 Greatest Occipital br.	—	—	108?	—	—	—	—	122?	114?
34 Frontal arc.	—	127	128	—	125?	—	120	126	130
35 Parietal arc.	—	—	125	—	127?	—	—	130	135
36 Occipital arc.	—	—	138?	—	—	107?	—	114	125
37 Frontal chord	—	110	113	—	111?	—	108	114	116
38 Parietal chord	—	—	114	—	110?	—	—	111	113
39 Occipital chord	—	—	112	—	—	85?	—	103	108
40 Length of first pre-molar to third molar	47	45	46	41	43(rt.)?	41(rt.)		—	45.5
Leng. of I Molar									
41 Right Antero-Posterior	9	11	10	—	—	—	—	—	10
Transverse	10	9	9	—	—	—	—	—	10
Left Antero-Posterior	10	11	10.5	10	9	—	—	-	10
Transverse	10	9	9	10	9	—	—		10
42 Length of II Molar (upper)									
Right Antero-Posterior	8	8	10	—	9	—	—	-	9
Transverse	8	8	6.5	—	6	—	—	—	9
Left Antero-Posterior	9	10	10	—	9	—	—	—	8
Transverse	8	10	7	—	7	—	—	—	9
43 Bi-orbitonasal arc.	—	—	112	—	110?	104?	—	—	—
44 Glabells nasion leng	—	12	12.5	9	11?	—	10?	11?	9
45 Nasion Lambda line	—	—	184	—	173?	162?	—	181?	175
46 Cranial capacity	1312cc?	1303cc?	1408cc?						

Index.	2	8	9	10	11	14	15	17	18
1 Length-breadth ind.	73.54?	76.72?	76.29?	66.51?	73.89?	91.86?	75.62?	81.11?	84.36
2 Length-height ind.	—	—	—	—	—	—	—	63.33?	72.63?
3 Breadth-height ind.	—	—	—	—	—	—	—	78.08?	86.97?
4 Total facial ind.	—	79.41	85.94	—	—	—	—	—	—
5 Superior facial ind.	—	42.65?	51.66	—	—	44.92?	—	—	48.90?
6 Nasal ind.	—	—	57.47?	66.22?	44.0?	67.44?	—	—	59.09?

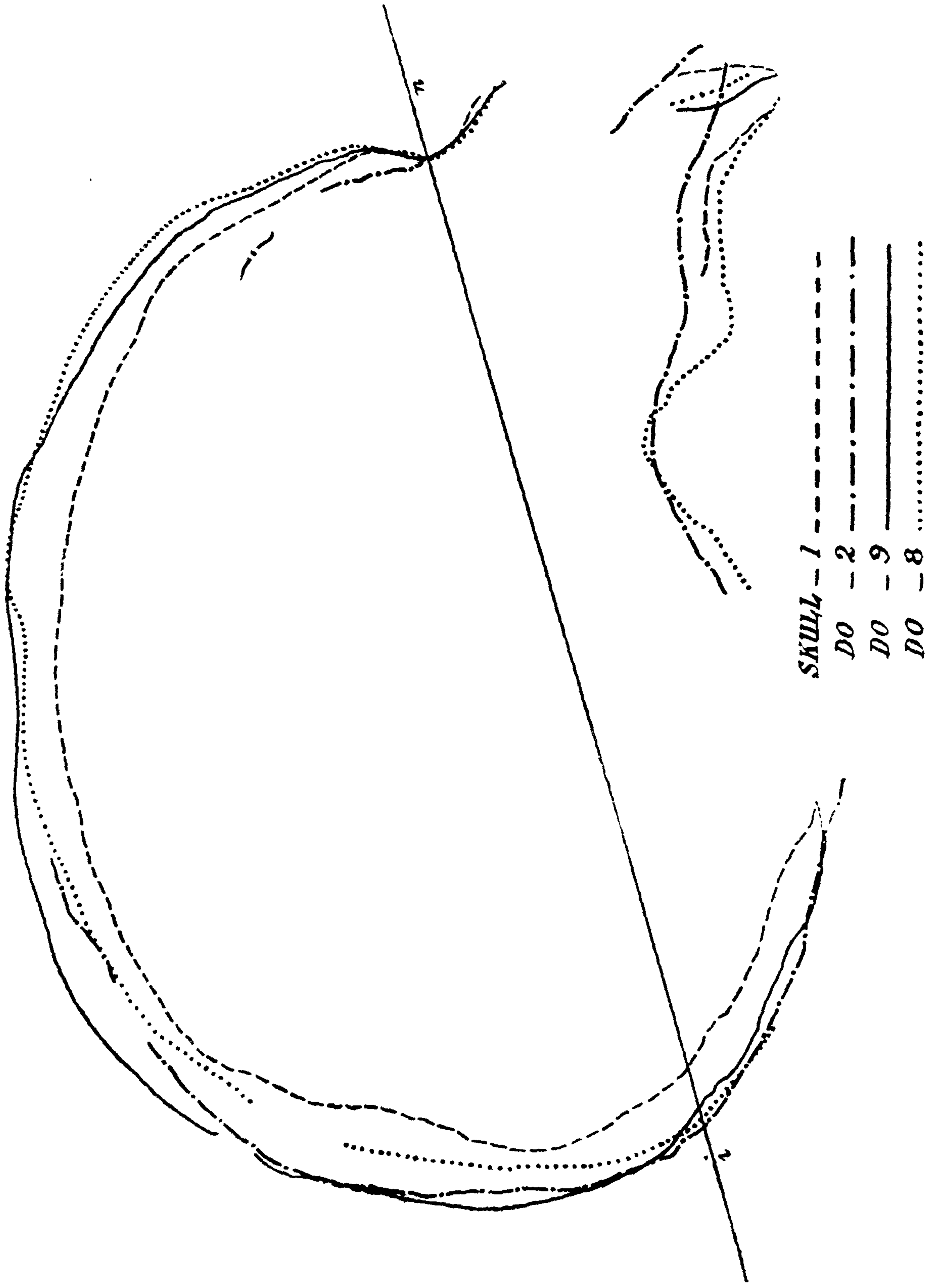

FIG. 37B. *Craniogram of skulls 1, 2, 9 and 8.*

6. ETHNIC AFFINITIES

A. Crania

Out of the 14 crania available in whole or in parts, 9 were suitable for purposes of measurement and skl. no. 15 belongs to a child on which much importance cannot be laid due to its tender age and doubtful pathological nature. The cranial measurements are given In Table IV.

Table IV

The cranial indices vary between the hyperdolichocranial index of 66.51 in the case of skl. no. 10 to the hyperbrachycranial index of 91.86 in the case of skl. no. 14. The nasal index could be determined in the case of 5 crania; it varied between the hyperleptorrhine index of 44.00 in the case of skl. no. 11 to the hyperlatyrrhine index of 67.44 in the case of skl. no. 14. The superior facial index, also known for 5 crania, varied between the hyperleptene index of 63.55 in the case of skl. no. 11 to the hypereuryene index of 42.65 in the case of skl. no. 8. The total facial index could be determined only in the case of the joint burial of skl. nos. 8 and 9 with the indices of 79.41 and 85.94 respectively. The cranial capacity was determined for skl. nos. 2, 8 and 9, all from joint burials-the values being 1312 c.c., 1303 c.c., and 1408 c.c. respectively.

Some of the selected measurements extracted from table, are given in Table V and compared with similar measurements of crania from other prehistoric sites. It will be seen from the above table that skl. nos, 2, 8, 9 and 11 have been grouped together showing a mean value for the above four crania, while the three other crania, skl. nos. 14, 17 and 18 form another group showing another mean value for them. For the sake of brevity we will call the former group I, and the latter group II.

The mean values of group I show a dolichocranial head form in contrast to brachycranial head form of group II. The mean cranial length of I is greater than that of II while the mean breadth is greater in the latter than the former. The nasion-inion length is 15.0 mm. longer in group I than that of group II, which is in conformity with A long type of head.

The horizontal circumference of the head is similarly greater in group I than that in group II. The mean bizygomatic breadth is greater in group II than that in group I, while the length of the upper face (n-pr length) is almost similar in the two groups. The superior facial index shows a slightly higher value in the case of group I than that of group II, both showing a short type of face. As opposed to the similarity in the form of the upper face the nasal index shows a higher value in group II than that of group I, the former being flat nosed while the latter is medium nosed.

The above differences in the measurements of the two groups are also apparent ip the median sagittal craniograms (text figs. 37B and 37C). Text-fig. 37B shows that of the four crania of group I superimposed upon one another, while Text-fig. 3 that of the three crania of group II.

Skl. No. 10 on the other hand shows the presence of another ethnic strain in having the longest cranial length of 212 (?) mm, but a cranial breadth (141 ? mm.) similar to the average of group I, and a hyperdolichocranial index of 66.51. The stature of this individual was found to be tall (p. 272) and a very flat nose with an index of 66.22 ? This type is represented by only one fragmentary specimen of a skull and may have some similarity with the Australoid ethnic strain found in the Indus valley (Guha and Sewell, 1931) and the hyperdolichocrania (group I of Vallois) from Sailk. The high breadth of this

cranium is a point of interest. It is probably in this character of the head that Lothal crania differ from the Indus Valley ones. The maximum head breadth reported is 136 mm in the Mohenjo-daro skull no. M. 27 (Guha and Basu, 1938), while the other crania from Mohenjo-daro show much lower breadth.

The mean head breadth of the Lothal I crania appears to be similar to the Group II dolichocephals from Sialk (Vallois 1940) and also those from al'Ubaid (Keith, 1927). There were three male crania of the above type from Sialk showing an average of 141.66 mm while the 8 male skulls from al'Ubaid vary between 134 mm and 145 mm, giving a mean value of 140.1 mm. Both the above means agree closely with that of the mean head breadth of group I crania from Lothal. In mean head length, the Lothal group I approaches the Kish (Buxton & Rice, 1931) crania but are different in total head form. The al'Ubaid cranial index however is different from that of Lothal due to greater cranial length of the former crania but the Sialk mean index of 74.76 agrees very closely with that of 75.11 of the Lothal dolichocephals. Besides there is a close agreement in the mean horizontal circumference of head between Lothal group I and Sialk Group II. There is slight difference in the superior facial index. Sialk II shows a medium form of face while the Lothal group I shows a short form of it. The close similarity in the nasal index will be apparent from the figures given in Table V.

Sialk is the only site which has yielded the largest number of brachycranial skulls-the largest having been found from period VI (Sarkar, 1960). A comparison of the mean values of Lothal group II and the eight male brachycranials (group IV of Vallois) from period VI of Sialk (Table. V) will show the above correspondence in the head form between the two. There is however some difference in the breadth of the face, which is slightly broader in Sialk IV than that of Lothal II and also in the nasal form of the latter, which is very platyrrhine. In these two latter characters the two Lothal groups appear to differ from one another almost as much as Lothal II differs from Sialk IV. It probably to shows some primitive hyperplatyrrhine element, an evidence of which is apparent in skl. no. 10 and in skl. no. 14, the most hyperplatyrrhine of all the Lothal crania presenting this character. The Australoid ethnic type, which is so frequent in India, might have contributed this into Lothal population. It will be obvious from the above description that the Lothal crania reveal a closer relationship both in their long-headed and broad-headed forms, with those of Sialk. Vallois has called the former Aryan and the latter Armenoids.

B. Stature

A few words might be said regarding stature of the Lothal population. It was possible to be calculated from the limb bones of the following skeletons.

Skl. no. 7	..	1856.20 mm (6′2″)
Skl. no. 10	..	1652.00 mm (5′6″)
Skl. no. 11	..	1800.6 mm (6′0″)
Skl. no. 16	..	1677.80 mm (5′7″)
Skl. no. 18	..	1620.50 mm (5′5″)

Skl. No. 10, as already mentioned, appears to be of Australoid ethnic type while skl. nos. 11 and 18 belong to group I and II of Lothal crania respectively. No skull of skl. no. 7 was found whereas that of skl. no. 16 was badly compressed laterally and the cranial length measured 190 mm. (p. 22). It appears in general to be similar to group I of Lothal.

It appears from the statures given above that the Lothal population varied from the below medium stature to very tall stature. The average stature comes to 1721.42 mm (5′ 8.9″) indicating a very tall type. Vallois (1940) was able to work out the stature of three

TABLE—V

Comparative Measurements of Lothal Crania

	Dolichocephals (71.0-75.9)									Brachycephals (81.0 above)				
	Lothal					Sialk	AL Ubaid	Kish	Mohen-jo-daro	Lothal				Sialk IV
	SKl Nos.									SKl Nos.				
Measurements	2	8	9	11	Mean					14	17	18	Mean	
Cran. Capacity	1312?	1303?	1408?	—	1341.0	1505	1408	—	—	—	—	—?	—	—
,, Leng.	189?	189?	194	180?	188.0	189.33	192.8	188	179.17	172?	180?	179?	177	179.8
,, br.	139?	145?	148?	133?	141.2	141.66	140.1	138	131.67	158?	146?	151	151.7	152
,, index.	73.54?	76.72?	76.29?	73.89?	75.11	74.76	72.60	73.32	71.87	91.86?	81.11?	84.36	85.44	84.60
Hori circumf	524?	537	538	—	533.00	534.66	—	522.3	518.67	525?	—	509	517	529.88
n-i length	—	181	179	169?	176.3	—	—	—	174.67	157	164?	163	161.3	—
n-pr. length	—	58?	66	68?	64.0	—	—	—	69.00	62?	—	67	64.5	—
Bizyg. br.	133?	136	128	—	132.33	131.33	—	—	123.00	138?	—	137?	137.5	140.79
Sup. fac. index	—	42.65?	51.66	—	47.16	55.5	—	—	56.96	44.92?	—	48.90?	46.91	53.16
Nasal ht.	—	—	43.5	50?	46.75	—	—	—	48.33	43?	—	44?	43.5	—
Nasal br.	—	—	25?	22?	23.5	—	—	—	22.50	29?	—	26?	27.5	—
Nasal index	—	—	57.47?	44.0?	50.74	49.73	—	—	45.63	67.44?	—	59.09	63.27	48.30

brachycephals from period VI of Sialk. This mean comes to 1693.3 mm. (5′7.7″) indicating a similarity with the Lothal average.

C. Upper Limb Bones

Among the long bones of the upper limb the left radius of skl. no. 18 was somewhat complete. Its measurements are given in (Table VI) along with a few of the two radii of skl. no. 11. It may be recalled here that the former skeleton belongs to a brachycranial person having a stature below medium, while skl. no. 11 to a very tall individual with a dolichocranial head.

TABLE—VI

Measurements of Radius (mm)

	SKl. 11		Skl. 18	
	(Lt)	(Rt)	(Lt)	(Rt)
Maximum length	—	—	255	—
Physiological length	47?	44	48	—
Least circumference of the distal half	47?	44	48	—
Sagittal diameter of the shaft	18	18	16	—
Transverse diameter of the shaft	13	13	14	—
Indices	138.46	138.46	114.29	—

Two humerii of the above two skeletons and the right one of skl. no. 10 were almost complete. Their measurements are given in (Table VII) skl. no. 10 belongs to a tall hyper-dolichocranial person. It will be clear from the measurements of Table VII how they vary along with the stature of the individual, skl. no. 11 being very tall, skl. no. 10 tall and skl. no. 18 below medium.

D. Lower Limb Bones

The lower limb bones were better preserved than those of the upper limb as a result of which more femora (Table VIII) and tibiae (Table IX) could be measured.

TABLE—VII

	Skl. 10	Skl. 11	Skl. 18	
	(Lt.)	(Rt.)	(Lt.)	(Rt.)
Maximum length	327	347	316	—
Physiognomic length	330	345	311	—
Breadth of prox. epiphysis	53	48?	49	—
Breadth of distal epiphysis	68	70	64	64?
Longitudinal diameter of the head	—	48.5	—	—
Transverse diameter of the head	—	48	—	—
Circumference of shaft at upper third	72	92	72	78
Lease circumference of the shaft	66	68	65	—
Caliber index	20.18	19.59	20.57	—

TABLE—VIII

Measurements of Femora

	Skl.6	Skl.7		Skl.10		Skl.11		Skl.16		Skl.18	
	Lt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.
Absolute length	—	—	—	—	—	512	503?	444*	464		
Physiological length	—	—	—	—	—	510	505?	444	460		
Trochanteric length	—	—	—	-	—	491	—	—	—		
Prox.dorso-ventral diameter	27	35	32	-	26	28	30	28	26	29	27
Prox.Medio-lateral diameter	34	41	40	—	36	31	32	33	35	27	27
Medial dorso-ventral diameter	31	40	—	33	35	34	35	28	35	34	34
Medial Medio-lateral diameter	29	35	—	24	25	29	30	31	28	28	26
Circumference of shaft	93?	117	—	94	99	100	100	93	99	99	94
Dorso-ventral diameter above the condyles	33	—	—	.	—	38			.	41	39
Medio-lateral diameter above the condyles	49			.	.	64			.	69?	72
Greatest medio-lateral breadth across epicondyles	—					80					-
Grestest dorso-ventral length of the lateral condyle	—	—	.		—	68	—		.		65
Greatest dorso-ventral length of the medial condyle	—	—	—	—	—	71		.	—	—	—
Bi-Condylar width	—	95	—	—	—	—	—	—	—	—	—
Platymeric index	79.41	85.37	80.00	—	72.22	90.32	93.75	84.85	74.29	107.41	100.0
Pilastric index	106.90	114.29	—	137.50	140.00	117.24	116.67	90.32	125.00	121.43	130.77
Pepliteal index	67.35	—	—	—	—	59.38	—	—	—	59.42	54.17

* shows healed fractured lower end.

E. Femora

It will be seen from Table VIII that skl. no. 7 shows the greatest robusticity of all, as could be seen in the circumference of the shaft being 117 mm. The majority of the femora is platymeric while the femur belonging to the brachycranial individual (skl. no. 18) is stenomeric. The same is seen in the case of the other brachycranial person under skl. no. 14 (p. 7). His right femur shows an index of 100 while the left that of 94.64. The right femur of skl. no. 11 however approaches the above index, it being 93.75. Hypotrochanteric fossa appeared to be rather common. It may be pointed out here that out of the 4 femora found in Megalith I of Brahmagiri (Sarkar, 1960) (p. 16), one, (c) is stenomeric with an index of 104.84, while the other three are platymeric. The majority of the crania from the above megalith is mesobrachycranial in head form.

Stenomeric femora are known as pathological ones (Wilder, 1920) and their association with the prehistoric population is not fully known.

The pilastric index of 11 Lothal femora varied between the minimum of 90.32 for skl. no. 16 and the maximum of 140.00 for skl. no. 10, with a mean of 118.81, compared 105.4, 115.5 and 108.6 for the 4 femora from Sialk (Vallois, 1940). The 4 Brahmagiri

femora showed a mean pilasteric index of 114.44, the range varying between 100.00 and 142.31.

The platymeric index of the Lothal femora, varied between the minimum of 69.44 for skl. no. 1 and maximum of 107.41 for skl. no. 18 with a mean of 87.00. The corresponding figures for Sialk are 74.5, 86.4 and 81.00. The four Brahmagiri femora showed a mean platymeric index of 81.97, the range varying between 66.87 and 104.84.

Compared with the high frequency of platymeria in the femora, there are only three platycnemic tibiae, (right of skl. no. 6, lefts of skl. nos. 7 and 18).

F. Tibiae

The platycnemic index was known for 8 tibiae (Table IX). It showed a mean value of 70.88, the range varying between 55.32 and 95.24. At Brahmagiri the four male tibiae showed a mean platycnemic index of 76.95, within a range of 71.83 and 88.00. There was no platycnemic tibia at Brahmagiri.

TABLE—IX

Measurements of Tibiae (mm)

	Skl.6		Skl.7		Skl.11		Skl.16		Skl.18	
	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.	Lt.	Rt.
Maximum length	—	—	440	446	—	434?	—		—	—
Maximum length	—	--	436	436	—	424?	—	-	—	—
Dorso-Ventral diameter (Prox)	41	41	49?	46?	38	42	39	-	45	43
Medio-Lateral diameter („)	25.5	27	35?	34?	28	29	23	—	29	29
Dorso-Ventral diameter (Med.)	33	36	47?	—	36	35	30	.	37	35
Medio-Lateral diameter („)	22	22.5	26?	—	24	25	21	-	22	23
Dorso-Ventral diameter (Dist)	—	30	37?	35?	--	32?	28		—	—
Medio-Lateral diameter („)	—	28?	37?	36.5?	—	31?	28	—	--	—
Circumference of shaft (Med)	86?	94?	119	—	95	89	80	-	93	94
Least circumference of shaft	78?	85?	108?	115?	—	87?	73	—	92	—
Platycnemic Index	66.67	62.50	55.32	—	66.67	71.43	70	—	59.46	65.71

7. SOME SPECIAL FEATURES

A. Traphination

This character has been found in skl. no. 15, which belongs to a child, about 9-10 years of age. It shows the antiquity of this surgical operation in Asia, so far it has been found in three crania from Lachish in Palestine (Risdon, 1939), which is dated about 701 B.C.

B. Cranial Fractures

The crania show fractures of very variable nature besides the comminuted fracture common to almost all the crania, it being due to the super-incumbent pressure of the soil above. A list of the fractures is given below.

Sk. 2—large opening approximately 120 mm long and 76 mm broad towards the left side of the vault.

Sk. 8—an oval depressed fracture on the left frontal and the left parietal; the fracture then runs in an oblique manner along the sagittal suture; two small fragments of the left parietal missing as well as a large fragment of the occipital.

Sk. 9—longitudinal fractures in three parallel rows on the vault of the skull; left side of the frontal shows a flat depressed area while the posterior portion of the parietal shows a wider fracture continued from the parallel rows mentioned above.

Sk. 11—an almost square depressed area on the left parietal; the right parietal shows a large number of small fragments of bones adhering together on the endocranial matrix; basal part below the palate missing.

Sk. 14—almost the whole of the left side comprises bits of broken bones adhering together on the left frontal sides, there are two openings, one large and one small on left parietal.

Sk. 17—shows the frontal bone broken into fragments adhering together on the endocranial earth, left parietal shows a flat depressed area.

Sk. 18—shows a square hole on the left frontal and a slightly bigger one on the right parietal.

C. Fractures of the Limb Bones

The limb bone fractures and cut-marks have been found on the following bones.

Sk. 6—The chopping marks on the left tibia appear to have been caused by some sharp weapon.

Sk. 11—The two tibiae show at the region of their least circumference (lower end) signs of fracture. It has not separated the bone into two pieces rather shows the characteristic adherence by the fibres of the bone as in the case of a bent bamboo splinter. It may be pointed out that the skeleton belonged to a very tall robust individual.

D. Joint Burials

The joint burials of the skl. nos. 2 and 3, and 8 and 9 appear to belong to the individuals of the same sex. Joint burial 2 and 3 were found to be nearly complete in all bones, whereas that of 8 and 9 did not show much of the lower part of the body. Joint burials have been reported from Maiden Castle (Wheeler, 1943) and also from the Lake Baikal region (Michael, 1958).

The joint burials are probably the results of simultaneous death and the factor which caused it in three pairs of individuals is difficult to be ascertained. Four of the six crania* from joint burials showed large cranial fractures, mentioned above, and the skulls of the rest two (nos. 3 & 13) were highly damaged. The cranial fractures mostly occur on the left side of the skull. skl. no. 6, whose tibia showed chopping marks caused by some sharp weapon, had its cranial vault in bits of broken bones but the face was intact. skl. no. 11 showed fractures both on the skull and the legs, while skl. no. 14 might not be a true burial Then the overwhelming majority of males, many of whom had not yet fully grown their wisdom teeth, does not indicate a normal population of an area.

Was Lothal the scene of battle ?[1]

[1].See Appendix II in this volume.

8. LIST OF LOTHAL SKELETAL REMAINS

A. *Skl. 1* Adult, male (?) SRG 8. B 1.

Vertebra	— 8
Rib	— fragments—1 lot
Clavicle	— fragments—1
Scapula	— fragments—2
Humerus	— fragments—5
Pelvis	— fragments—4
Sacrum	— complete— 1
Femur	— fragments—2 (Rt)
Patella	— right —1
Unidentified fragments	— —1 lot.

B. *Skl. 2* (Adult, male) joint burial with skl. 3 SRG 8. B 1.

Skull	— 1 damaged.

Right lateral incisor and right upper canine missing in the skull found along with skeletal remains

Mandible	— 1 nearly complete
Rib	— fragments—1 lot
Sternum	— fragment—1
Scapula	— fragment—1
Clavicle	— shaft fragment—1 (Rt).
Humerus	— fragments—2
Radius	— fragment—1
Pelvis	— fragment—1 (Lt)
Femur	— shaft fragments—2 (Rt).
Patella	— 2 (Rt. & Lt.)
Tibia	— 2 (Rt. & Lt).
Fibula	— shaft fragments —3 (Rt. & Lt).
Tarsal	— 2
Metatarsal	— 2
Unidentified fragments	— 1 lot
Animal bone	— fragment—1

C. *Skl. 3* (young, adult) (joint burial with skl. 2) SRG 8. B 1.

Skull	— Represented by a distorted and laterally compressed skull cap and 2 fragments of maxilla
Mandible	— 1, nearly complete
Vertebra	— fragments—10
Sacrum	— fragments—3
Rib	— fragments—1 lot
Scapula	— fragment—1
Clavicle	— fragment—1
Humerus	— shaft fragments —2; appear to belong to two individuals one robuster than the other. The robust bone appears to be of skl. 2.
Ulna	— shaft fragments—2
Radius	— shaft fragments—3

Metacarpal	— 7
Phalange	— 6
Pelvis	— right and left fragments—2
Femur	— shaft fragments—6; (Rt. & Lt).
Patella	— 2 (Rt. & Lt).
Tibia	— 2 nearly complete (Rt. & Lt).
Fibula	— shaft fragments—2
Tarsal	— 8 (Rt. & Lt).
Metatarsal	— 2
Phalange	— 2
Unidentified fragments	— 1 lot

D. *Skl. 4* (ADULT, MALE) SRG 8. A 1.

Rib	— fragments—1 lot
Sternum	— fragment—1
Scapula	— fragments—2
Humerus	— fragments—3 (Rt).
Radius	— fragments—4 (Rt).
Ulna	— fragments—2 (Rt).
Carpal	— 1
Metacarpal	— 5 (Rt)
Phalange	— 1
Unidentified fragments	1 lot

E. *Skl. 5* (ADULT) SRG 8. D 1.

Skull	— Represented by a fragment of right parietal and occipital
Isolated tooth	— 1 (upper molar II)
Mandible	— fragments—2
Vertebra	— 1 lot
Sacrum	— 1
Ribs	— fragments—1 lot
Scapula	— fragments—1
Clavicle	— fragments—2
Humerus	— fragments—3
Femur	— fragments—1
Unidentified fragments	— 1 lot

F. *Skl. 6* (ADULT, MALE). SRG 8. D 1.

Skull	— Skull found in bits of broken bones, only facial portion and the cranial base preserved, right orbit missing.
Mandible	— complete
Ribs	— fragments—1 lot
Scapula	— fragments—1
Clavicle	— fragments—4 (Rt. and Lt.) 2 fragments of a slender built individual.
Humerus	— fragments—3 (Rt. & Lt.)

Radius	— fragments—3 One appears to belong to a slender built person and the third to an infant
Ulna	— framtents-4, two appear to belong to a slender built person
Carpal	— 4
Metacarpal	— 4
Phalange	— 4
Pelvis	— fragment –1
Tibia	— 2 (Rt. & Lt.) the left tibia shows at its lower end chopping marks of a sharp weapon
Fibula	— shaft fragments—2 appears to belong to two individuals one slender built, one robust.
Tarsal	— 5
Metatarsal	— 6
Phalange	— 3
Unidentified fragments	— 1 lot
Animal bones	— 5

H. *Skl. 7* (ADULT, MALE) SRG 8. D 1.

Mandible	— Damaged
Vertebra	— 1
Sacrum	— 1
Rib	— fragments—1 lot
Scapula	— fragments—4 (Rt. & Lt).
Clavicle	— fragment—1
Humerus	— fragments —4 (Rt. & Lt).
Radius	— fragments –2 (Rt. & Lt).
Ulna	— 2, right nearly complete left one fragment
Pelvis	— fragments—2 (Rt. & Lt).
Femur	— fragments—3 (Rt. & Lt).
Patella	— 1 (Rt).
Tibia	— 2 (Rt. & Lt).
Fibula	— fragments –4
Tarsal	— 3
Metatarsal	– 2
Unidentified fragments	— 1 lot
Animal bone	— fragment –1

I. *Skl. 8* (ADULT, MALE) JOINT BURIAL WITH SKL 9 SRG 2, W 26.

Skull	– 1
Mandible	— 1 damaged
Vertebra	— fragments 16
Sacrum	— 1
Rib	— fragments –1 lot

Sternum	— fragment—1
Scapula	— fragments—2
Humerus	— 1 (Rt).
Radius	— 1 (Lt).
Ulna	— 1 (Lt). probably of skl 9
Carpal	— 6
Metacarpal	— fragments—12
Phalange	— fragments—7
Femur	— fragments—5 One of the five fragments appears to belong to a slender built individual
Pelvis	— 1 (Lt).
Unidentified fragments	— 3
Animal tooth	— 1

J. *Skl. 9* (ADULT, MALE) JOINT BURIAL WITU SKL 8 SRG 2. W 26.

Skl.	— 1
Mandible	— 1 nearly complete
Vertebra	— 5
Rib	— fragments—1 lot
Clavicle	— fragments—3
Scapula	— fragment—2
Humerus	— fragment—6 (Rt. & Lt)
Radius	— shaft fragments—3
Ulna	— shaft fragments—2 (Rt. & Lt). (probably of skl 8)
Pelvis	— fragments—6
Patella	— 1
Unidentified fragments	— 1 lot.

K. *Skl 10* (ADULT, MALE)' SRG 8. B 2.

Skull	— 1, damaged, only left side cloud be fairly restored
Mandible	— fragments—2
Vertebra	— 19
Ribs	— fragments—1 lot
Sternum	— fragments—2
Scapula	— fragments—3 (Rt. & Lt).
Clavicle	— fragments—2 (Rt. & Lt).
Humerus	— complete—1 (Lt). fragments—3
Ulna	— Left almost complete—1 fragment—2 (Rt.)
Radius	— 2 (Rt. & Lt)
Carpal	— 11
Metacarpal	— fragments—14
Phalange	— 23
Pelvis	— fragments—6 (Rt. & Lt).
Femur	— complete right —1 fragments — —3 (Lt).
Patella	— 2 (Rt. & Lt.)
Tibia	— fragments—5

Fibula	— fragments—2
Tarsal	— 9
Metatarsal	— 3
Unidentified fragments	— 1 lot

L. *Skl 11* (ADULT, MALE) SRG 8. B 1.

Skull	— 1 (damaged)
Mandible	— 1
Vertebra	— 1 lot
Sacrum	— fragments—2
Ribs	— 1 lot
Clavicle	— 1 (Rt).
Scapula	— fragments—4
Humerus	— 1 complete (Rt).
Ulna	— 2 (Rt. & Lt).
Radius	— 2 (Rt. & Lt).
Carpal	— 4
Metacarpal	— fragments—8
Pelvis	— fragments—6 (Rt. & Lt).
Femur	— 2 (Rt. & Lt).
Patella	— 1
Tibia	— 2 (Rt & Lt)
Fibula	— 2 (Rt. & Lt.)
Tarsal	— fragments—4
Metatarsal	— fragments—17
Phalange	— 1 lot
Animal bone	— 1 fragment

M. *Skl* 13 (JOINT BURIAL (?) WITH SKL 14) ADULT, MALE, SRG 2. X 26.

Skull	— 1 (damaged)
Mandible	— 1
Rib	— fragments —2
Clavicle	,, —2
Humerus	— ,, —2
Radius	— ,, —3
Ulna	— fragment —1
Carpal	— ,, —4
Metacarpal	— fragments —7
Femur	— fragment —1
Patella	— ,, —1
Fibula	— fragment —1
Tarsal	— 1
Phalange	— fragments —4
Unidentified fragments	— 6
Animal bone	— fragments —6

N. X 24. *Skl 14* (JOINT BURIAL (?) WITH SKl 13) ADULT, MALE SRG 2.

Skull	— 1
Mandible	— 1

Vertebra	— 1 lot
Sacrum	— 1
Rib	— 1 lot
Scapula	— fragments —4
Clavicle	— 2 (Rt. & Lt).
Humerus	— fragments —5
Radius	— fragments —3
Ulna	— ,, —4
Carpal	— ,, —1
Metacarpal	— ,, —4
Phalange	— ,, —3
Pelvis	— ,, —4
Femur	,, —5
Unidentified	— 1 lot
Animal bone	fragments —2

O. *Skl 15* (CHILD, 9-10 YEARS) SRG 8. E 2.

Skull	1, as found in the field (Trepanned)
Mandible	— 1, complete
Vertebra	— 1 lot
Sacrum	— fragment — 1
Humerus	— 2
Ulna	— 2 (Rt. & Lt).
Radius	fragments —3
Pelvis	fragments —4 (Rt. & Lt)
Femur	— 1
Tibia	— fragments —2 (Rt. & Lt).
Fibula	— fragments —2
Tarsal	— 4
Metatarsal	— 4
Phalange	— 2
Unidentified fragments	1 lot

P. *Skl 16* (ADULT, MALE) SRG 8. E 2.

Skull	1
Rib	— fragments —6
Ulna	,, —2
Carpal	,, —2
Metacarpal	fragments —4
Pelvis	— 1, left appears to belong to the second individual mentioned below.
Femur	— nearly complete—3 (Lt. 2 & Rt. 1) One of the left femora belongs to a second individual robuster than the the present, the other left femur appears to show a healed fracture resulting into the lower end bent medially
Patella	— 1
Tibia	— nearly complete—2, both belong to the left side—one of which may be correlated with the femur of the second individual.

Fibula	— fragment – 1
Unidentified	— 1 lot
Animal bones	— 3 fragments

Q. *Skl 17* (ADULT, MALE) SRG 8. C 2.

Skull	— 1
Mandible	— 1
Vertebra	— 1 lot
Rib	— 1 lot
Scapula	— fragment —1
Clavicle	— fragments —4
Humerus	— ,, —5
Radius	— ,, —3
Femur	— ,, —4
Ulna	— ,, —3
Patella	— ,, —2
Tibia	— ,, —4
Fibula	— ,, —2
Tarsal	— ,, —2
Metatarsal	— ,, —2

R. *Skl. 18* (ADULT, MALE) SRG 26

Skull	— 1
Mandible	— 1
Clavicle	— 2 (Rt. & Lt).
Scapula	— 3 fragments
Rib	— 1 lot
Sacrum	— 1
Vertebra	— 1 lot
Humerus	— 2 (Rt. & Lt.)
Radius	— 2 (,, ,,)
Ulna	— 2 (,, ,,)
Carpal	—10
Metacarpal	— 7
Pelvis	— 3 fragments
Femur	— 2 (Rt. & Lt.)
Patella	— 2 (,, ,,)
Tibia	— 2 (,, ,,)
Fibula	— 2 (,, ,,)
Tarsal	—15
Metatarsal	— 9
Phalange	—24
Unidentified	— 1 lot

S. *Skl 19* (ADULT, MALE) SRG 8. E 3.

Tarsal	—13 (Rt. & Lt.)
Metatarsal	—10 (,, ,,)
Phalanges	— 4

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CHAPTER XVI

SEALS AND SEALINGS[1]

INTRODUCTION

Seals are the most distinctive objects of the commercially prosperous Harappan settlements in the Indus Valley and Kathiawar.

With the exception of Kalibangan in Rajasthan (pl. CL) other Harappan sites in India have not yielded seals in any considerable number.

A significant contribution made by Lothal is that it has adduced evidence to show that the Indus seals were used for sealing cargo. Clay sealings found in the Warehouse bear on the obverse the positive impressions of seals, while on the reverse impressions of twisted cords tied into knots (pl. CLI A-B) and of packing material such as reeds and loosely woven fibres (pl. CLXI E) are seen. The Lothal seals were also used for sealing jars as can be made out from the pinched clay along the rim of the sealing. A clay sealing found at Rupar (pl. CLI B) is only a lump of clay on which impressions of three seals were taken but bears no sign of use on any package or jar. Kalibangan has yielded a few sealings bearing impression of packing material. The explanation offered by some scholars for the absence of sealings used on packages in the Indus valley sites is that the clay labels used on packages must have disintegrated as they were not subsequently baked for better preservation. From the evidence so far available, baking of sealings at Lothal may be accidental, but the possibility of deliberate baking cannot be ruled out. It may be recalled here that in West Asia clay tablets were baked for keeping them as permanent records.

Some seal-impressions of the type found at Harappa and Mohenjo-daro are also noticed at Lothal (pls. CLXIV B-C), but they are all unbaked and do not show marks of use. They are just positive impressions taken on a lump of wet clay held in the palm or between wooden strips (pl. CLXII C *2*) as can be made out from the impressions of the lines on the palm and of wooden strips left on the sealings One of the sealings found at Lothal is of faience and bears impressions of two seals one each on the obverse and reverse. Such objects in clay and faience found at Harappa and Mohenjo-daro are also called sealings by the excavators for want of a better term. Some of them are unsuitable for affixing on packages as they are solid unperforated cylinders.

Out of 91 sealings from Lothal 71 come from the passages of the warehouse and are found baked. Among the rest from the township area ten sealings are baked indicating thereby that baking was not accidental but deliberate and they were fired only after being taken away from the packages to which they were attached. The bulk of the sealings found in the passages of the warehouse is assignable to phase III and a few to phase IV. The sealing no. 1759 found at a depth of 18 ft. 5 ins. in layer 37 of SRG 2, B 6 and assignable to phase I bears two impressions of a rectangular seal measuring .75 ins. × .5 ins. on the obverse and has a groove on the back suggesting that it was affixed to a package covered by reed.

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[1]*Note*—Seals appear as they are in the plates. Positive impressions taken from seals are not illustrated to avoid confusion with the sealings.

[2]*Indian Archaeology*, 1961-62—*A Review*, pl. LXIX A.

2. SEALS (fig. 38A)

A. Frequency of Occurrence

Indus seals were in use at Lothal from the earliest phase of occupation to the latest in Period A and to a small extent in Period B also. The earliest seal (No. 1760) made of steatite comes from layer 37 of SRG 2, B 6, from a depth of 21 ft. below surface. Unfortunately, it is very much damaged and except for a portion of the motif, namely the unicorn, nothing can be seen on the obverse, while on the reverse faint traces of a perforated boss are visible. Another seal (No. 5371) from phase I is made of copper. It is square in plan and has a loop ring which seems to have been soldered and not cast. The unicorn standing to the right and the Indus script are crudely engraved. If the seal was cast the script and motif would have been executed better. Among other seals from very early levels is a square seal (No. 989) made of greenish soap-stone without any coating. It bears the usual unicorn to the left and one line of script above it on the obverse, while on the reverse there is a perforated boss. These three examples make it very clear that burnt steatite, copper and soapstone were used from the earliest times for making seals. Animal motif engraved faces left and rarely right, the shape of the seal being usually square and occasionaly rectangular. Seals of small size which are very few in number are not confined to the earliest phase, nor are the crude seals earlier in date. In fact seals in different stages of manufacture and finish are found in almost all the phases. The crudity in the case of steatite seals is more due to their unfinished nature than any decadence in the art of engraving.

The phase-wise break-up of the seals reveals that the maximum bumber comes from phase III and the least from phase V. It is doubtful if the seals of phase V were used at all for sealing packages. In two of them the depth of engraving does not produce good impression. In another the engraving is deep and the script is clear. Apparently the small village settlement at Lothal in phase V did not trade on any appreciable scale as the dockyard had fallen into disuse and the artisans and merchant classes had dwindled.

B. Material

Steatite of light grey colour has been used in the manufacture of most of the seals at Lothal. Because of the softness of the material it can be easily cut, engraved and polished. Quite often the steatite paste was pressed into a mould, dried and then engraved and heated for making seals, but this process was not adopted for ornaments. Three categories of steatite seals have been distinguished. Category A consists of seals made of soapstone with a white coating of the same material producing a greasy lustre. They show a considerable proportion of magnesia and silica. Category B consists of seals made of of steatite paste with a pearly lustre and they crumble in moisture. Seals of soapstone without any greasy coating are included in category C. Besides steatite, agate, ivory and and copper were also used, though they are hard to cut and engrave. Terracotta seals are not infrequent.

C. Cutting and Engraving

The process of preparing seals is fairly clear from lumps of steatite and partially-cut blocks found at Lothal (pl. CLII A). A rectangular block of steatite was first sawn to the required size and shape. The basis on which Marshall concludes that the average size of

the saw used was 0.25 inch is not known, but it is likely that a copper saw of thin blade was used for cutting agate and chert seals while a thick copper wire could have served the same purpose in the case of softer material like steatite. The second stage was to produce a rough square boss, if the seal was to have one, on the reverse, by cutting out saw the unnecessary portions (pl. CLII B). Marshall says that it is at this stage and before rounding off the boss that the device and characters on the obverse were cut after smoothening the surface with an abrasive, and that a groove running across the centre of the boss was then made by a V-shaped cut.[1] But the unfinished seal shows clearly that the boss was rounded off and perforated even before engraving the script on the obverse. The hole for the ring, by which the seal used to be held was bored with the help of bronze drills of the flanged type (pl. CCXXIX B 3-4) dipping towards the centre from two sides. The idea was to carry the hole across rather than along the cleavage planes right into the substance of the seal. If the boss were to be knocked off, as it has happened in many cases, the ring could still pass through the hole in the substance of the seal itself. If the boss was broken, the seal was sometimes thinned out except in the centre where a new boss was produced in low relief (pl. CLII C). But for the groove which makes it look double the boss is hemispherical in shape and, in a few cases, occupies less than one-third the space on the reverse. Sometimes a transverse hole, instead of an axial one was bored, especially when the seal had a plano-convex or pentagonal or triangular section without a boss (pl. CLV D 1). It is only in the case of the copper seal that a loop-ring has been provided instead of the boss or simple perforation. Unperforated but finished seals are also recovered from Lothal (pl. CLV C).

The tool used for engraving depended upon the material of the seal. For soft substances like steatite, terracotta and soapstone, engravers of chert, ivory and bone were used. In the case of harder substance such as agate and shell chisels and engravers of copper and bronze were necessary. Engravers of shell (fig. 138; pl. CCLXXX A 2-3) bone (pl. CCXCI) and ivory (pl. CCXCII) found at Lothal have a lunate-like or crescentic shape with one or both margins polished for convenient handling. Among other types are parallel-sided blades of chert with a sharp point and a blunted or polished margin (fig. 122; pl. CCLIV). The curvature in the case of engravers in shell facilitated smooth movement of the tool and application of greater pressure at the end. Marshall mentions the use of burin.[1] If he meant a lithic tool produced in the burin technique, it must be said that none has been found in the Indus Valley or Kathiawar.

From the examples of unfinished seals (nos. 5099, 15294, 6184 and 12923) found at Lothal it becomes fairly clear that at times the script was carved first and the motif was added later. In each of the examples cited above some space is left blank for engraving the animal. But the steatite seal no. 5228 is the only example wherein the animal is carved first, space being left blank for engraving the script. Before engraving the script, it appears, the seal was damaged at the corner and had to be rejected. The unfinished steatite seal no. 5008 (pl. CLIII B) is a good example of commencing from right while engraving the script. This seems to be the main reason for the smaller size of the letters above or near the head of the animal in some cases. Seals nos. 5228 and 14371 further suggest that the outline of the animal was drawn first and other details such as trappings on the body were subsequently worked out. The last act in the manufacture of seals was the application of the white coating.

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[1]Marshall *op. cit, 1931, II*, p. 378

[2]*Ibid*

[3]Notes : Only important seals are illustrated here. The legend on all the seals is given in figs. 28-31.

FIG. 38A. Seal types from Lothal

D. Coating

Mr. Horace Beck is of the opinion that the surface of the steatite seals was painted with an alkali and then subject to heat. A careful examination of the alkaline coat indicates the application of more than one coat of the liquid, and even overlapping of brush marks. Coating was mostly resorted to when the stone used was grey or greenish in colour. The chemical analysis[1] has indicated that the covering film is made of the same material as the seal itself and appears to have been applied. After the application of the coating the seal was baked to produce the white exterior while the core itself remained grey or greenish and hardness was produced with the escape of water from the core. A closer examination of the seals reveals that engraving was done before the seal was fired. Had they been engraved after applying the white film as presumed by Marshall,[2] the core should have been visible in the depressions. In rare cases, however, the coating was not properly applied and consequently the core is visible. Seals nos. 989, 6425, 2762 etc., are examples of absence of any coating. The chemical analysis of the white film covering the surface of the seals shows the following composition :

Silica	..	61·2 percent
Oxides of aluminium and iron		2·4 percent
Lime	..	Nil
Magnesia	..	34·6 percent
Water (by difference)	..	1·8 percent
		100·00 percent

The quantity of water varies upto 2·17 per cent in some cases. The surface substance is therefore said to be steatite or talc that has been deprived of the greater part of its water, which is only possible by ignition.

E. Types (fig. 38A)

The following types of seals have been distinguished on the basis of shapes.

Type I	Square	
Type II	Rectangular	
Type III	Cylindrical	
Type IV	Rectangular	With a transverse triangular or pentagonal section.
Type V	Plano-convex	
Type VI	Circular	
Type VII	Miscellaneous	

Cylinder seals of the type found in West Asia, with a circular section and axial perforation meant for fixing a ring, were not in use at Lothal. One of the types found here has a more or less rectangular section with bevelled edges, but no perforation. The bevelling of the edges is rather accidental. Cube and round seals are also unknown here. The most common type is the square one with a rectangular section and perforated boss. Some seals are rectangular in plan. Seals with a triangular or pentagonal section are generally

[1]Marshall *op. cit*, 1931 II p. 379.
[2]*Ibid* pp. 378-379

rectangular in plan and smaller in size than the average square type. Where the seal was thin and narrow a hole was made in the triangular or pentagonal section. A unique non-Indus type found at Lothal is what is known as the 'Persian Gulf Seal'. It is circular on plan.

(i) Type I : Square seals

Square seals with a perforated boss on the reverse were very popular at Lothal as in Harappa and Mohenjo-daro. In all, 32 seals have been found in this group and the following sizes are noted :

0·5 × 0·5 ins.
0·6 × 0·6 ins.
0·7 × 0·7 ins.
0·8 × 0·8 ins.
0·9 × 0·9 ins.
1·0 × 1·0 ins.
1·2 × 1·2 ins.
1·3 × 1·3 ins.
1·5 × 1·4 ins.
1·5 × 1·5 ins.

The materials used are terracotta, steatite, faience, ivory and soapstone. The motifs engraved include the unicorn, short-horned humpless bull and the mountain goat. The terracotta seal no. 1938, an agate seal no. 3658 and two unfinished seals namely 5099 and 15294 bear only the legend but no motif. A unique motif noticed on a terracotta seal no. 11358 is what looks like a seed-drill in the upper panel. The legend is engraved in the lower panel (pl. CLIXC 5). Evidence is also available regarding the re-use of worn-out seals. The upper layer of steatite seal no. 8768 is chopped off for re-engraving.

A second sub-type among square seals has a loop-ring. There is but one example of it in copper with a loopring (fig. 38A) soldered to the body. The legend and motif namely unicorn to right are crudely engraved.

The third sub-type consists of stamp on button seals. Square seals bearing a linear design but no script or animal device found at Lothal are more or less similar to what Marshal calls button seals with linear designs. He thought that they were used as pintaderas as in Danubian II, Thracian Copper Age, Early Greece etc., for stamping impressions for religious purposes or caste-marks. But in Lothal they must have been used for a commercial purpose, as indicated by the terracotta sealing no. 1292, 1833 and 14586 bearing impressions of cords and reeds on the back. Apparently they were used for sealing packages. Three out of six square stamp seals from Lothal, namely nos. 9048, 12271 and 15031 bear the *svāstika* in double or single line with one line added between each arm in two cases. Two of them are made of steatite and one is of faience. Seal no. 15285 has a boss on the back as in other square seals but the design on the face is of a cross or plus (+) in double lines.

(ii) Type II: Rectangular seals

The second main type consists of seals which are rectangular on plan. Most of them do not have any boss on the back nor are they perforated. Only a few seals have a perforated boss and a few others a transverse perforation in the triangular or pentagonal section without any boss.

The following sizes may be noted among the rectangular seals some of which bear linear motifs and are comparable to the stamp seals.

1.6 × 0·8 ins.
1·6 × 0·7 ins.
1·5 × 0·6 ins.
1·4 × 1·2 ins.
1·4 × 0·7 ins.
1·3 × 0·9 ins.
1·3 × 0·5 ins.
1·2 × 1·0 ins.
1·2 × 0·6 ins.
1·1 × 0·6 ins.
1·0 × 0·9 ins.
1·0 × 0·8 ins.
1·0 × 0·6 ins.
1·0 × 0·5 ins.
0·9 × 0·7 ins.
0·8 × 0·6 ins.
0·8 × 0·4 ins.
0·6 × 0·5 ins.
0·6 × 0·4 ins.

There must be several other sizes but owing to the fragmentary nature of the miniature seals full measurements are not available. As such, fragments are omitted for purposes of recording size.

An important subtype and fairly popular is the rectangular seal with a perforated boss. Teracotta seal nos. 6184 and 4346 (pl. CLX E) have very prominent perforated boss on the back and bear the legend on the face. The margins are not perfectly parallel in the case of seal no. 4346. In an unifnished seal (no. 6124) some space is left blank for the motif to be engraved. Certain peculiarities are noticeable in the case of the terracotta seal no. 15288, wherein a unicorn is drawn crudely in the upper panel instead of in the lower, and a plant-like motif emerging from the manger can be seen. The large boss at the back is damaged, but a white coating similar to the one on steatite seals is applied to this terracotta seal. Seal no. 13263 of greyish steatite with white coating has a barrel-like boss running transversely but the perforation is axial.

Lothal B has yielded only one seal assignable to this group. It bears linear signs on the obverse and has a perforated boss on the reverse.

The second sub-type in rectangular seals has neither a boss nor any perforation. Twelve such seals of various materials such as terracotta, steatite, agate and soapstone are found at Lothal. Excepting the unfinished seal no. 5228 (pl. CLXB) none of them bears any animal motif. A steatite seal with two circlets and a terracotta one with Indus Script are from period B. The rest which come from period A are all inscribed. The absence of any animal or other motifs suggests that it was not always an essential part of the seal. These unperforated seals such as nos. 5228 and 9989 which have a thin section do not provide the necessary grip for impressing on wet clay labels. A few others, for example, seals nos. 1123, 3062 and 10824 are, however, thick enough to be held properly. In the case of seal no. 13027 there is a depression on either side to provide the necessary grip.

The third sub-type consists of perforated rectangular seals without any boss. Among the five seals of this type found at Lothal three have one transverse hole each, while the fourth has two transverse perforations and the fifth one a vertical hole in addition to a

transverse one. Excepting one which is made of steatite, all are of terracotta, but none of them carries any motif. Apparently they were held by means of a ring passing through the transverse hole but the purpose of the vertical hole in terracotta seal no. 15287 is not clear (pl. CLVI A). Similarly the use of two transverse perforations in a few other seals is also not clear.

The fourth sub-type can be compared to stamp seals, but the solitary specimen in terracotta (pl. CLIX C, 2) bears a peculiar motif of dots along the margin, the opposite corners being joined by diagonals. Some dots are seen in the enclosure also. Most of the stamp seals from Lothal carry no button or loop on the reverse, and therefore appear to serve a purpose different from the round stamp seals of Jhukar and Shahi Tump cultures.

(iii) Type III: Cylindrical seals

Mention has already been made of the fundamental difference between the cylinder seals from West Asian sites and the square or rectangular seals of Lothal. The section in the latter case is almost rectangular (Fig. 38A) and the bevelling of the edges is accidental. There is no perforation to fix the ring and the inscription is confined to the plain surface. None of the three seals from Lothal which are more or less cylindrical carry any motif nor can they be used in the manner of West Asian cylindrical seals to take more impresions. The size of cylinder like seals of Lothal varies from 1·5 ins. × 0·5 ins. to 1·7 ins. × 0·7 ins., and the materials used are terracotta and steatite.

(iv) Type IV: Rectangular perforated seal with transverse triangular section

Seals of this type are essentially rectangular on plan but they are treated as a separate category because of the perforation across a transverse triangular section in the absence of a boss on the back. Only two seals of this type are found at Lothal. Seal no. 12923 made of steatite is 1·1 × 0·6 ins. and unfinished as the space below the legend meant for the motif is left blank. Seal no. 14875 made of terracotta is 1·5 × 0·9 ins. and bears only the script.

An important sub-type in this group is rectangular in plan and has a longitudinal pentagonal section. Seals of this type are very narrow in width and thin in section. Out of the six seals listed here three are intact and the other three are damaged. The two sizes noticed among the complete ones are 1·2 × 0·4 ins. and 0·9 × 0·3 ins. They are all transversely perforated and have no boss. The ends are truncated and the section is therefore pentagonal (fig. 38A). None of them bears any motif but the script is beautifully engraved. These seals seem to have been moulded and the material used is a paste of steatite.

(v) Type V: Plano-convex seals

Only two examples of plano-convex seals are found at Lothal. Seal no. 1258 in terracotta is a fine specimen, tiny, well-modelled and carefully engraved measuring 0·6 × 0·3 ins. The second seal (no. 469) is of greenish steatite (pl. CLX D), unfinished and unperforated. Being damaged, it appears to have been rejected. Only one letter and a few scratches are seen on the obverse.

(vi) Type VI: Persian Gulf (Bahrain) *seal* (Fig. 38A; pl. CLXI-B-C)

A circular steatite seal found from the unstratified deposits on surface at Lothal is of great importance for cross-dating the site understanding the trade relations existing between Lothal and Western Asiatic countries. It is neither Indian nor wholly Sumerian in form and motif engraved. On the contrary, it closely resembles the seals from Bahrain and Failaka recently found by Prof. Glob and Dr. Bibby in their excavations. Sir Mortimer Wheeler has designated them as 'Persian Gulf seals' which, according to him "appear to

have been made at the various entrepots (such as Bahrain itself) of a cosmopolitan Persian Gulf trade of the kind, which has been analyzed by A. L. Oppenheim from Larsa tablets".[1] Prof. G. Bibby is inclined to identify Bahrain with Dilmun mentioned in the clay tablets from Ur, while Prof. S. N. Kramer thinks that Dilmun was in the Indus Valley. Whatever the identification of Dilmun be, it is evident from clay tablets that it was an entrepot on the trade to India. Lothal being the only sea-port of Indus Civilization, which has yielded the Persian Gulf seal, it can be considered as having contact with Dilmun. The Lothal seal is made of light grey steatite and has a creamy coating. It is 1·9 ins. in diameter with a boss on the back covering almost the entire surface, and divided by triple lines drawn in one direction and perforated in the other. Four circlets with a central dot are also drawn on the back, while on the face is a reptile or dragon having two heads and flanked by two jumping goats or gazellelike animals with protruding eyes and looking over the shoulder. None of these figures has any resemblance to Indus motifs. On the contrary, the goat-like animals on the seal under discussion are more like the Sumerian goats. The Lothal seal closely resembles the circular stamp seals of steatite found in the excavation at Barbar and Ras-al-Qala in the island of Bahrain[2], where they originated and were used by merchants who traded with the Indus and Sumerian ports. Some of the late circular seals from Failaka, a little island near Kuwait assigned by Dr. Bibby to the Sargonid period, are identical in all details with the Lothal seal. The earlier ones from Failaka are said to belong to the pre-Sargonid period.

(vii) Miscellaneous

This group consists of 20 seals all of which are damaged to such an extent that their complete shape cannot be made out. In most cases the animal motif is partially visible but the portion bearing script is completely or partly missing. Six seal-like objects in this group are rejected in view of the fact that there is no legend or motif but only some scratches on them.

Among the more recent finds is a rectangular steatite seal with a rectangular perforated boss. Two double concentric circles on the reverse and four Indus signs on the obverse can be made out. The boss and circles are reminiscent of the Persian Gulf seal but the shape and workmanship are Indian (pl. CLIV A). Another interesting type is roughly rectangular on plan (pl. CLXI D.) with Indus signs neatly engraved on the obverse. The reverse is uneven and has no perforation or boss.

It was found essential to illustrate the seals in the photographs as they actually appear in order to bring out clearly the distinction between seals and sealings i.e., the negatives and positives, both of which are found at Lothal. Marshal, Mackay and Vats have illustrated the mirror impressions as they should be read. For purposes of reading, the mirror impressions of seals are given along with the writing on sealings in Fig. 25 (Vol. I)

Plates-Seals

Pl. CLIII A

Steatite: *Obv.* Indus signs and unicorn. *rev.* segmented boss, with perforation; phase II SRG 3 AX 1[3], layer 10; 5.5″[4] (3017)[5]

[1]Wheeler *Antiquity* XXXVIII, 152, pp. 307-309.

[2]T G. Bibby, *Antiquity* XXXII, pp. 243-246.

[3]SRG 3, AX 1=Cutting SRG 3, grid AX 1.

[4]The reference is to the depth below surface.

[5]The reference is to the antiquity number.

Pl. CLIII B

Steatite seal; example of engraving Indus script commencing from right. From phase III (5008).

Pl. CLIII C

Soapstone; *Obv:* Swastika; boss; *rev.* phase II; SRG 3, D 6, pit sealed by layer 3; 1'5" (12277).

Pl. CLIV A

Steatite; *obv.:* Indus script.
rev.: Boss and Indus script. Surface find. Front and back views.

Pl. CLIV B

Side views of above seal with Indus script engraved on sides.

Pl. CLIV C

Copper: *obv.* Indus signs and unicorn;
rev. Boss; phase I; SRG 2, B 9, layer 22; 14'8" (5371).

Pl. CLV A

Soapstone; *obv.* Indus signs only;
rev. Boss; phase II; SRG 3, BX 2, Layer 5; 4'2" (15263).

Pl. CLV B

Steatite; *obv.* Indus signs; *Rev.* plain with axial perforation; phase IV. SRG 2, GX 9; layer 2; 1'1" (14370).

Pl. CLV C

Agate; *obv.* Indus signs; *rev.* plain; damaged, phase III; SRG 3; B—C 5; layer 4-6; 4'4" to 4'3" (5228)

Pl. CLV D

1. Terracotta; *obv.* Indus signs: *rev.* plain with axial hole; phase III; SRG 2, unstratified (14875).
2. Terracotta; *obv.* Indus signs; *rev.* plain. phase III: SRG 2, B 15; layer 15; 6'8" (3062).

Pl. CLVI A

Terracotta; *obv.* Indus signs; *rev.* plain with transverse hole; damaged; phase II; SRG 2, FX 4, layer 2; 1'22" (15287).

Pl. CLVI B

1. Steatite; *obv.* Indus signs; *rev.* axial hole; phase III; SRG 2, B 27—C 27; layer 3; 1'02" (3269).
2. Terracotta; *obv.* Indus sign; *rev.* convex back with axial hole; phase III; SRG 2, A 6; layer 10; 4'8" (1258).

Pl. CLVI C

1. Steatite; *obv.* Indus sign with unicorn and fire altar; ger; *rev.* segmented boss, slightly scratched; phase II; SRG 2, B 14; layer 12; 8'3" (4879).

2. Steatite; *obv.* Indus sign and unicorn with fire altar; *rev.* button borken; seal phase damaged; II; SRG 1, IX-XII layer 13; 6'0" (407).

3. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* segmented boss; phase III; SRG 2, layer 8 C, (6726).

4. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* segmented boss; phase III; SRG 2, E 2 pit sealed by layer 13; 6'8" (5450).

Pl. CLVII A

1. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* segmented boss broken; seal damaged; phase III, SRG 3, E 4; pit sealed by layer 2; 2'2" (6492).

2. Steatite; *obv.* Indus signs and unicorn; *rev.* segmented boss broken, seal damaged; phase V; SRG 2, C 24 layer 2; 0'9" (8736).

3. Steatite; *obv.* Unicorn with fire altar; Indus signs damaged; *rev.* Boss intact; seal damaged; phase II-III; SRG 3, GX 10; layer 3, 1'8" (1758).

4. Steatite; *obv.* Indus signs and unicorn with damaged fire altar; *rev.* segmented boss broken; seal damaged; phase III; SRG 3, BX 3, layer 9, 4'10" (5321).

Pl. CLVII B

1. Soapstone; *obv.* Indus signs and unicorn with fire altar; *rev.* segmented boss; damaged; phase IV; SRG 3, CX 8, layer 4; 1'10" (4261).

2. Soapstone; *obv.* Indus signs and unicorn with fire altar; *rev.* segmented boss unperforated; crude; phase IV; SRG 2; E 1, layer 4; 2'6" (5397).

3. Soapstone; *obv.* Indus signs and unicorn with fire altar; *rev.* button broken; phase I; SRG 1, XII-XVII; pit sealed by layer 19; 19'2" (989).

4. Soapstone; *obv.* Indus signs and unicorn with fire altar; *rev.* button broken; phase IV; SRG 3, E 4; pit sealed by layer 2; 1'5" (6425).

Pl. CLVII C

1. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* broken button; weathered; phase III; SRG 2 B 25, layer; 2'11" (15163).

2. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* boss chopped off; phase III; SRG 3, B 4; layer 4; 3'5" (7341).

3. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* broken button; seal damaged, phase IV; SRG 2, S.C. (14976).

4. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* segmented button; phase III; SRG 2, B 25 layer 5; 2'11" (15164).

5. Steatite; *Obv.* Indus signs and unicorn with fire altar; *rev.* round segmented boss; phase III; SRG 2. B 17, layer 7, 5'4" (4262).

6. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* round segmented boss; phase IV; SRG 2 N 3, layer 2, 0'10" (9675).

Pl. CLVII D

1. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* round segmented boss; phase III; SRG 58, VIII-IX; layer 4; 3'5" (16883).

2. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* round segmented boss; top broken; phase II; SRG 55; IX-XIII; layer 4; 5′0″ (15462).

3. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* no. boss; traces of axial perforation visible; phase I; SRG 2, E 13, layer 25; 14′2″ (17328)

4. Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* segmented boss with perforation; seal damaged and weathered; phase III; SRG 62; 0-III; layer 4; 4′0″ (17369).

5. Soapstone; *obv.* Indus signs and unicorn with fire altar; *rev.* no boss; axial perforation visible; seal damaged; phase III; SRG 2; D 14, layer 6; 6′7″ (16767).

Pl. CLVIII A

Steatite; *obv.* Indus signs and unicorn with fire altar; *rev.* segmented boss and perforation; worn out; phase III; unstratified (15338).

Pl. CLVIII B

1. Soapstone; *obv.* Indus signs and unicorn with fire altar; *rev.* Button broken; seal damaged; phase III, SRG 2; B 17; layer 8; 4′6″ (5617).

2. Soapstone; *obv.* Indus signs and unicorn; rev. boss broken; seal damaged; phase III; SRG 2, C 25, layer 4; 3′7″ (14371).

3. Steatite; *obv.* Indus signs and unicorn; *rev.* boss broken; seal damaged; phase V; SRG 2, unstraatified (14865).

4. Steatite; *obv.* Hind parts of unicorn visible; *rev.* boss broken; seal damaged; phase IV; SRG 3, CX 2; layer 3; 1′8″ (12028).

Pl. CLVIII C

1. Steatite; *obv.* fire altar and damaged unicorn visible; *rev.* boss broken; seal damaged; phase IV; SRG 2 JX 3; layer 3; 1′6″ (11806).

2. Ivory; *obv.* worn out Indus signs and unicorn with fire altar; *rev.* boss broken; phase III; SRG 1; 1; XIV—XX; pit sealed by layer 3; 4′0″ (5958).

3. Soapstone; *obv.* unicorn and fire altar; visible but Indus signs obliterated; *rev.* segmented boss; surface probably rubbed for reuse; phase IV; SRG 3, C 6, layer 2; 0′11″ (8767).

Pl. CLVIII D

1. Steatite; *obv.* fire altar and front of unicorn visible; *rev.* button broken; seal damaged; phase III; SRG 2; C 25; layer 9; 4′9″ (12276).

2. Steatite; *obv.* hind part of the animal visible; *rev.* button broken; seal damaged; phase III, SRG 2; B 17, layer 9; 3′7″ (5625).

3. Steatite; *obv.* Indus signs and bull; broken *rev.* boss chopped off; real damaged; phase III; SRG 2; B 27 (5984).

4. Soapstone; *obv.* unicorn and Indus signs partly visible; *rev.* no boss; seal damaged; phase II; SRG 2; C 1; layer 16; 6′7″ (2899).

5. Steatite; *Obv.* unicorn and fire altar partly visible; *rev.* no boss; seal damaged; phase I, SRG 2 B 6, layer 37; 18′5″ (1760).

Pl. CLIX A

1. Steatite; *obv.* hind part of tiger with a long tail and prominent claws on the feet; *rev.* plain; seal damaged; phase IV; SRG 2; D 5; layer 5; 3′2″ (13699).

2. Steatite; *obv.* Indus signs and short-horned humpless bull with trough; *rev.* boss chopped off; seal damaged; phase III; SRG 2, B 27, layer 9; 4'3" (5784 b).

3. Steatite; *obv.* Two lines of Indus signs and a mountain goat with back-sweeping horns and fire; altar; *rev.* boss; phase III, SRG 2; B 9; layer 7; 4'0" (4829).

4. Steatite; *obv.* Indus signs and short-horned bull in charging posture with a trough; *rev.* boss; phase II SRG 2; B 8, layer 11; 7'2" (5040)

Pl. CLIX B

Terracotta; *obv.* Indus signs and humpless, short-horned bull; *rev.* button broken; seal damaged due to over-firing; phase IV; SRG 2, M 28, layer 4: 2'6" (13338).

Pl. CLIX C

1. Terracotta; *obv.* anthropomorphic signs; *rev.* plain; phase III; SRG 3, D 2, pit sealed by layer 5; 2'10" (6947).

2. Terracotta; *obv.* A series of notches along the margins joined by diagonal lines; *rev.* boss intact; phase IV; SRG 2; C 25; layer 4; 1'10" (9074).

3. Steatite; *obv.* sparrow and Y-shaped trough; *rev.* plain; damaged; phase I; SRG 1; XI-XIV: layer 18; 15'7" (529).

4. Terracotta; *obv.* Peculiar Indus signs; *rev.* button broken; phase III; SRG 2, FX 4; layer 4 3'0" (15288).

5. Terracotta; *obv.* seed drill above and Indus signs below. *rev.* button borken; phase IV; SRG 2; C 25; pit sealed by layer 2; 1'0" (11358).

Pl. CLX A

1. Soapstone; *obv.* Indus signs; *rev.* plain with axial perforation; phase IV; SRG 2; D 2; pit sealed by layer 3; 1'8" (6047).

2. Soapstone; *obv.* Indus signs; *rev.* plain with perforation; crude; phase III; SRG 2; C 5 layer 6A; 3'7" (12923).

3. Soapstone; *obv.* Indus signs; *rev.* irregular; phase IV; SRG 1; AX 1; layer 2; 0'11" (2762).

4. Agate; *obv.* Indus signs; *rev.* plain; phase III; SRG 3; C 2; layer 7; 3'8" (9989).

Pl. CLX B

1. Terracotta; *obv.* Indus signs; *rev.* plain, axial hole; seal damaged; phase III; SRG 2, A 7, layer 2; 1'1" (3870).

2. Terracotta; *obv.* Indus signs; *rev.* plain, axial hole; seal damaged; phase IV; SRG 2, AX 3, layer 2; 0'10" (3453).

3. Terracotta; *obv.* Indus signs; *rev.* plain, axial hole; seal damaged; phase III; SRG 2, B 5, layer 6; 4'0" (1123).

4. Terracotta; *obv.* Indus signs; *rev.* plain, axial hole; seal damaged; phase III, SRG 3, FX 6, layer 3—8, 2⁴ to 4'6" (13017).

Pl. CLX C

1. Steatite; *obv.* Indus signs; *rev.* plain, axial hole; seal damaged; phase III; SRG 2, AX 4, layer 3; 1'9 (4133).

2. Steatite; *obv.* Indus signs; *rev.* plain, axial hole; phase II; SRG 2, Unstratified (12341).

3. Steatite; *obv.* Indus signs; *rev.* plain, axial perforation; seal damaged broken; phase IV; SRG 2,

L 28 pit sealed by layer 2; 0'11" (13004).

4. Steatite; *obv.* Indus signs; *rev.* plain, seal damaged; phase III; SRG 2, P 28; layer 4, 2'9" (13994).

5. Steatite; *obv.* Indus signs; *rev.* plain, broken; phase III; SRG 2, D 24; layer 4' 4'1" (13732).

Pl. CLX D

1. Soapstone; *obv.* Indus signs; *rev.* plain; seal damaged; phase III; SRG 3, B 6, layer 5, 2'6" (9716).

2. Steatite; *obv.* Indus signs; *rev.* plain; seal damaged; phase III; SRG 2; D 2; layer 4, 2'2" (6070).

3. Soapstone; *obv.* Indus signs; *rev.* plain, seal damaged; phase I; SRG 1; IX—XI, layer 15, 10'3" (469).

4. Agate; *obv.* Indus signs; *rev.* irregular; saw marks visible; phase III; SRG 2, E 2, layer 4; 2'5" (3658).

Pl. CLX E

1. Terracotta; *obv.* Indus signs; *rev.* plain, with axial perforation; seal damaged; phase IV; SRG 1; XI—XIV; layer 13; 5'5" (400).

2. Terracotta; *obv.* Indus signs; blank space left for engraving motif. *rev.* button with axial perforation; unfinished; phase V; SRG 2, B 10 layer 13; 6'9" (5094).

3. Terracotta; *obv.* Indus signs; *rev.* button with vertical hole; seal damaged; phase IV; SRG 3, FX 10 layer 2; 2'9" (1938).

4. Terracotta; *obv.* Indus signs; *rev.* segmented button with perforation; seal damaged; phase IV; SRG 2, AX 6; pit sealed by layer 6; 2'7" (4346).

5. Terracotta; space left blank for engraving motif; *rev.* button intact; unfinished; phase III; SRG 2, unstratified. (6184).

Pl. CLX F

Soapstone; *obv.* only animal motif; *rev.* plain; broken; phase III; SRG 3; J 3; 2'0" (15264).

Pl. CLXI A

1. Steatite; *obv.* effaced swastika; *rev.* boss with perforation; weathered; phase IV; SRG 3; C 6, layer 3, 1'4" (9082).

2. Yellow steatite; *obv.* effaced swastika; *rev.* boss with perforation; weathered; phase V; SRG 6, unstratified. (15031).

3. Soapstone; *obv.* Indus sign; *rev.* broken boss; seal damaged; phase V; SRG 2, unstratified. (2421).

4. Steatite; *obv.* two roundels; *rev.* plain seal damaged; phase V; SRG 13; VII-VIII; layer 5; 5'5" (15444).

Pl. CLXI B

A: Steatite; *obv.* Two jumping gazelles with large eyes flanking a double headed dragon-like reptile; *rev.* large perforated boss with four double circlets and dot; circular; unstratified, diameter 1.3 ins.

Pl. CLXI C

B: Impression of the above seal.

Pl. CLXI D

Steatite; *obv.* Indus signs, *rev.* perforated boss and two double-circles; unstratified; 1.25 × .8 ins.

3. SEALINGS (Fig. 38B pls. CLXII to CLXIV)

A Process of Sealing

A careful examination of the impression on the back of the terracotta sealings from Lothal has revealed the process of sealing cargo. After wrapping the packages with vegetable fibre mats, reeds or textiles they were securedby tying cords around them. Thereafter the knots were covered with labels of wet clay and finally impressed with seals. The packages were thus authenticated and secured against pilfering. Sealing no. 13191 (pl. CLXI E) bears on the reverse impressions of a fabric of plain weave as also of reeds or hay and of cords fastened around the packing material. The obverse bears the impression of a seal with Indus signs and unicorn. It is further observed that the wet clay on the margin was pressed with fingers. Another remarkable feature noticed in some sealings is the multiplicity of seals used in sealing the package. The sealing no. 8737 bears on its convex obverse impressions in bold relief of three different seals, two of which bear only the Indus signs. The reverse of the sealing is partly flat and partly concave wherein impressions of twisted cords overlacing one another and tied into a knot are clearly seen. The flat surface may suggest that the seal was used on a bottle or jar-stopper. Sealing no. 1864 bearing Indus signs and an elephant motif on the obverse and impressions of overlacing cords on the flat undersurface (pl. CLXI F) must have been used on a jar closed by a flat stopper across which cords were tied. Sealing no. 1867 seems to have been affixed to the stopper of a narrow-mouthed jar. The pinched clay on the margin of yet another sealing (no. 1292; pl. CLXII A) indicates that it was used on a wide-mouthed jar. The impression of a compa tmented square design on the sealing suggests that stamp seals were also used like any other seal. Among other sealings indicative of their use on cargo is one (no. 14986) bearing impressions of twisted cords and reeds on the reverse. Other examples are sealing nos. 2077 (pl. CLXII D) and 1888 (pl. CLXII E). Finger-nail marks are also visible on the obverse of some sealings (14586, 1867, 1864, 8737 etc.).

B. Baking

Out of 90 sealings bearing the seal-impressions as many as 69 have been recovered from a small area of 3 ft. × 3 ft. at the southern end of the eastern-most passage between two bases of the warehouse. (pl. LXXVII B) the southern end of which was closed with kilnburnt bricks. Rice-husks have also been found in the mud-plaster used on the bases which have turned red due to firing. It appears that the sealings got burnt accidentally in the warehouse when it caught fire. Lothal was a major port on the western sea-board of India and carried on extensive trade not only with the Indus valley cities but also with the West Asian ports such as Ur, Failaka etc.

C. Type, (fig. 38B)

Sealings can be broadly divided into two categories. The first category consists of sealings which were only trial pieces bearing the impression of a seal without being actually used for sealing purpose. The second category consists of sealings which carry impressions of one or more seals on the obverse and of packing material on the reverse. Sealings bearing a single impression were generally used on bottle-mouthed jars covered with a stopper, while those with multiple impressions seem to have been used on large packages wrapped in reeds, mats and cloth. But there are exceptions also, for example, the sealing no. 1292 with

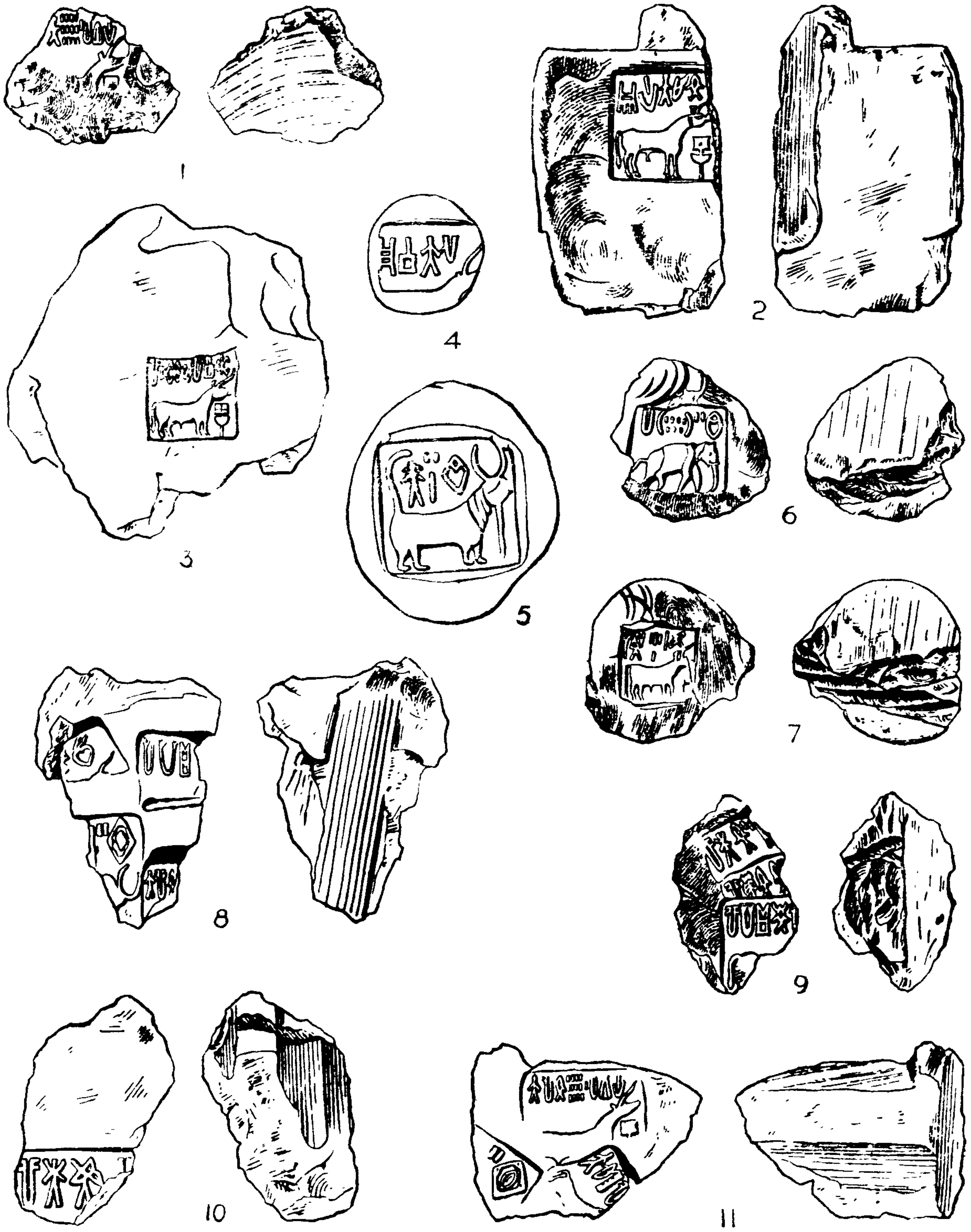

FIG. 38 B. *Sealings, Scale 1/1*

two impressions of a stamp seal is found to have been used for sealing a narrow-mouthed jar. Similarly, the sealing no. 13191 with a single impression was used on a package wrapped in cloth over reed mat. The sealing no. 13651 was a trial piece, taken by pressing a seal over a lump of wet clay held in the palm. Its convex reverse bears palm-lines while on the obverse a peculiar animal combining features of elephant, bull etc. is seen.

Among the Lothal sealings bearing a single impression are twelve terracotta sealings with the running elephant motif (pl. CLXI F) below four Indus signs on the obverse. There are other sealings too of which several copies are available. Almost all of them bear the unicorn and Indus script on the obverse and impressions of cords tied into knots on the reverse. Obviously several packages must have been sealed by the same seal. Alternately, a package had been secured by sealing it in different parts. The finger impressions on the margin and the nail-marks on the top of the elephant sealings indicate that after affixing the seal the surplus clay was pressed back with fingers. The fact that very often it is the animal motif which is obliterated while pressing wet clay suggests that the legend on the sealing was more important than the animal motif.

Three sealings nos. 3694, 5242 and 1883 (pl. CLXIII D) bear reed-marks on the reverse and Indus legend on the obverse, but there is no animal motif. In (pl. CLXIII E) three sealings witn impressions of the same seal but the animal motif obliterated, are illustrated.

Impressions of a cord running across the reed can be seen on the reverse of the sealing no. 1838 (pl. CLXII E).

Pl. CLXIII C illustrates sealings wherein only the animal motif is fairly clear but the portion carrying the legend is missing due to damage. The motif on sealing no. 1835 appears to be of a bull while the one on sealing no. 1855 is too faint to be made out. The motif on sealing no. 1837 is also suspected to be a bull.

The sealing no. 14856 baked to a greyish colour does not carry the legend or animal motif but only an impression of a cross mark enclosed by an artistic border. The finger impressions on the obverse and the impressions of a cord and reed on the reverse clearly indicate that this stamp seal was also used for sealing packages.

Sealings no. 722 and 1984 (pl. CLXIIC) which are partially baked, bear impressions of two different seals in each case. On the analogy of sealing no. 1292 it may be said that these two sealings were also used as jar-stoppers.

The sealings nos. 1845 and 1870 (pl. CLXIV E) are triangular on plan and well-baked. Reed-marks are visible on the reverse of both. Sealing no. 1870 bears impression of three seals and sealing no. 1845 of four, but two impressions are common to both. In the upper left hand corner of sealing no. 1870 there is a short-horned bull motif below a letter. The same letter is seen in the lower left hand corner of sealing no. 1845. Impressions of another seal with seven Indus signs are noticed on both in the lower panel.

A very remarkable feature of the sealings found in the warehouse is that out of twelve sealings, (1853, 1845, 1884, 1873, 1870, 1927, 1888, 1871, 1876, 1838 and 1857) bearing the impression of the same seal with seven letters at least two are found to bear impressions of other seals also. This may indicate that sometimes an individual exported goods by himself or in collaboration with others who also affixed their seals. It is doubtful if the same individual had more than one seal. Twelve copies of a sealing carrying seven Indus letters and unicorn on the obverse are also found but unfortunately the animal motif is obliterated while pressing clay in most cases.

Sealing no. 2077 (pl. CLXII D) carries on the obverse impressions of two seals and on the reverse a deep groove left by a stick or reed covering the package to which it was fastened. In one of the impressions on the obverse Indus script and a motif resembling a crocodile can be seen. The second impression is too faint to be made out.

Sealings no. 1881 and 1857 have faint impressions of two and three seals respectively. Both the impressions in sealing no. 1881 appear to be of the same seal while in sealing no. 1857 all the three impressions are of different seals, the motif in two being unicorn. In the third impression the motif is not visible. Thick reed-marks are visible on the reverse.

On the reverse of sealing no. 1888 (pl. CLXII E) impressions of a bamboo mat can be clearly seen besides the cord-marks on the right hand margin. On the obverse are two seal-impressions in one of which 7 letters and a unicorn are seen. It is interesting to find that both the impressions are repeated on sealing no. 1845.

Sealing nos. 1292 and 1833 (pl. CLXII A) carry impresions of stamp seals. A compartmented square design is seen in sealing no. 1833 while sealing no. 1292 bears two impressions of a seal with swastika motif produced by drawing parallel lines in cordinal directions. On the reverse of sealing no. 1292 pinched clay projecting in the form of a circle clearly indicates that it was used over a narrow-mouthed jar. On the reverse of sealing no. 1833 faint cord-marks can be seen suggesting use on cargo secured by string.

The terracotta sealing no. 13191 bears on the obverse the impression of a seal engraved with Indus script and unicorn motif while on the reverse the impressions of a cloth of plain and loosely woven fibre and of two cords (pl. CLXI E) are visible. In this connection, it may be mentioned that textile-impressions on pottery are reported from Kaligangan[1] and Alamgirpur. For the first time the Lothal sealing proves the use of seals on packages wrapped in cloth and covered with bamboo strips or reeds. Whether the cloth was made of jute, cotton or flax is not known.

Sealing no. 12352 (pl. CLXIV D) made of faience was not actually used for sealing any package, as it bears impressions of seals on both the obverse and reverse. Here we can see a short-horned bull and a unicorn together below the legend on one side of the sealing, while on the other, the legend alone is noticed. Both the surfaces are flat. In view of the fact that faience sealings are scarce at Lothal the present seal-impression may not have been a mere trial piece. In the absence of perforation it could not have served as an amulet either.

4. MOTIFS

Most of the seals from Lothal bear animal motifs and very few of them carry geometric and other designs such as segmented squares and swastika. On only one seal a seed-drill is engraved. Among the animals engraved on seals the unicorn is the most popular. Hitherto it was believed that the unicorn was only a mythical figure and nothing comparable to a single-horned animal of the unicorn type actually existed. Recently, a terracotta head of a single-horned animal (pl. CCVI C) closely resembling the unicorn seen on Indus seals has been found at Lothal. One such figure is reported from Kalibangan also. Unless such animals actually existed in the protohistoric period, the artist would not have rendered them on seals and produced a terracotta model. If the artist meant a two-horned animal there was no necessity to produce a single-horned animal in terracotta. Other animals depicted on seals and sealings are the elephant, the short-horned bull, the mountain goat and the tiger. A bird is seen on a small steatite seal. A composite animal occurs on a terracotta sealing and an anthropomorphic figure on a terracotta seal.

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[1]*Indian Achaeology*, 1961-62, A Review, pl. LXVIII A.

A. Frequency of Occurrence of various motifs:

		Seals	Sealings	Total
1.	Unicorn	37	17	54
2.	Elephant	—	1	1
3.	Short-horned bull	2	5	7
4.	Bird	1	—	1
5.	Tiger	1	—	1
6.	Mountain goat.	1	—	1
7.	Composite animal	—	1	1
8.	Anthropomorphic figure	—	—	—
9.	Buffaloe	—	—	—
10.	Long-horned bull	1?	(only horns are seen)	1
11.	Human forms	—	—	—
12.	Gharial	—	1	1

This excludes copies of the same seal or sealing.

B. Animals Represented on Seals and Sealings

(i) Unicorn

Mention has already been made of the popularity of unicorn in Lothal seals. It is a male beast resembling the ox. It has a long tufted tail and pointed horn. A Mohenjo-daro seal shows two unicorn heads one with a single horn and the other with two horns. Through the traditional unicorn of heraldry made up of different parts of a number of animals is said to have originated in India the Indus unicorn does not resemble the mythical animal. Ctesias and Aristotle call the unicorn of heraldry the Indian ass. The single or double line markings on the shoulder of the unicorn on Lothal seals are similar to those on the Indus valley seals and represent trappings. The lines around the neck of the animal varying in number from 6 to 8 may represent folds of the skin and the horizontal strokes against double vertical lines represent wire ornaments. The unicorn on seal no. 8736 is not marked with any line on the neck while the animal on seal nos. 6492 has eight lines besides the trappings and wire ornament. In the case of most of the unicorns the eye and eye-lid are very prominently marked but there are a few instances e.g., seal no. 989 (pl. CLVII B) in which they are not clearly indicated. In a majority of cases the eye is set in its proper place in the head while in some others it is more like the camel's eye.

The standard-like object that always occurs with the unicorn motif except in unfinished seals consists of two parts. The upper object rests on a bowl-like object which itself is supported by a staff. Sometimes a series of points are noticed along the rim or around the bowl. The staff does not have as broad a base as a dish-on-stand in pottery and cannot therefore be compared with it. Marshall thinks that the staff like support may be of wood or metal, while the bowl is of basket-work or leather, the object above the bowl being made of wood, metal or basket-work. The standard represents the 'fire altar' or 'fire post' and the vertical lines drawn in 3 tiers represent fire in 3 forms or places. (See Appendix II)

The total absence of the long-horned Brahmani bull on Lothal seals and sealings suggests that merchants who used the bull symbol did not live at Lothal.

(ii) Short-horned bull

The excavation has yielded two seals and one sealing on which the short-horned bull (pl. CLXIII C, 2-3) is clearly visible while on four more sealings the hind part of the bull is seen. A faience sealing (pl. CLXIV D) bears impressions of a bull with its head bent over a trough. Though the horns are slightly long in this case other features clearly suggest that what the artist meant was a short-horned bull. The bull on the steatite seal no. 5040 (pl. CLIX A) has lowered its head, not to charge as suggested by Marshall[1] in the case of Mohenjo-daro seals, but to feed itself from the trough placed in front of it. Such low concave sided troughs in terracotta are found at Lothal in considerable numbers and must have been used for offering fodder and water to the animals and not for enticing an angry bull. The charging bull in terracotta from Harappa, Mohenjo-daro etc., is fearful to look at but the bull depicted on the Lothal seals is calm and serene. An Indus type seal with the short-horned bull-motif and inscribed in cuneiform writing is found to have travelled to Ur in the course of trade.

(iii) Elephant (Elephas maximus)

No seal with elephant motif has been found at Lothal, but on ten sealings, all of which bear impressions taken from a single seal, the running elephant is depicted in great detail. Although the elephant motif occurs on some Indus Valley seals the inscription they carry is different from the one noticed on Lothal sealings. As such the owner of the sealings from Lothal cannot be traced to the Indus Valley. There is no object in front of the elephant in any seal. This animal is now extinct in Kutch and Kathiawar, but it must have existed in Western India in the second and third millennia B.C., as Kautilya refers in his *Arthaśāstra* to the short stature of the elephants from Saurashtra (Kathiawar)[2]. The ivory tusk and humurus of the animal found in the excavations at Lothal support the literary evidence.

(iv) Tiger (Felis Tigris)

The animal depicted on the steatite seal no. 13699 (pl. CLIX A,1) represents a tiger as can be made out from the prominent stripes. It is interesting to note that the claws are rather exaggerated and the tail has a thick bunch of hair. As the head-portion is missing it is not known whether an anthropomorphic figure such as 'tiger-man' was meant.

(v) Composite animal

The composite animal depicted on the obverse of a terracotta sealing no. 13051 (pl. CLXIV B) having a convex reverse is very interesting. This animal has the horns, fore-legs and face a Brahmani bull, and the trunk and tusks of an elephant. The tail is erect like a snake. The cloven hoofs, long erect horns and the thick neck, however, suggest that what was meant is a Brahmani bull *(Bos Indicus)* in a composite form.

(vi) Goat

The goat engraved on seal no. 4829 (pl. CLIX A, 3) has the face and ear of a unicorn rather than a goat, but the beard, long twisted horns and short raised tail and lines meant

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[1]Marshall, *op. cit.* 1931 *II.* p. 382.

[2]*Kautilya's Arthaśāstra* (ed) R. Shamasastri (1960) p. 49

to show the folds of skin on the neck clearly indicate that the animal meant is a mountain goat. There is a standard in front of it.

(vii) Gharial (Gavialis Gangeticus)

A crocodile is faintly visible on a sealing which bears two impressions of the same seal. Similar motifs occur on Indus Valley seals too.

(viii) Bird

A bird beautifully engraved on a tiny seal (no. 529) looks more like a crow rather than a sparrow. In front is an object which is exactly like one of the pictographs in the Indus writing.

Among the Indus animals totally absent on the Lothal seals and sealings mention may be made of the rhinoceros, buffalo, antelope and the typical Brahmani bull. Mythological figures, human and plant forms are also not engraved. It is surprising that the lion is not at all represented on the Lothal seals and sealings though the Gir forest in Kathiawar was the habitat of lions.

Usually, the animals are shown standing to the left in the seals. However, on a copper seal the animal is shown standing to right.

Seed-drill is the only unusual motif noticed on a terracotta seal at Lothal.

C. Geometric and Linear Designs

The swastika with arms turned to right is engraved on three seals. This evidently shows that in the positive the swastika had arms turned to left. One additional stroke between each arm is seen in seal no. 9082, while two additional strokes are noticed in seal no 15031. On sealing no. 1292 (pl. CLXII A) the positive impression shows swastika with its arms turned to right drawn in multiple lines which means that in the seal the arms turn to left. Hence as in Mohenjo-daro and Harappa both the types of swastika were adopted in Lothal too. The jointed double 'T' and 'divided squares' or cheque pattern are among other geometric designs occurring on the seals and sealings from Lothal.

Plates-Sealings

Pl. CLXI E

Terracotta; *obv.* Indus signs and fairly visible horn of unicorn; *rev.* interlacing reed-marks and textile impression; well baked, damaged; phase IV; SRG 3, L 5, layer 8, 0'10" (13191).

Pl. CLXI F

Terracotta; *obv.* Indus signs and elephant in walking posture; *rev.* groove seen; well-baked, damaged, phase II-III; SRG 3, GX 10; warehouse, layer 2, 2'0" (1830).

Pl. CLXII A

1. Terracotta; *obv.* two impressions of swastika; drawn in multiple lines as in the stamp seals of Brak *rev.* plain; well-baked, damaged; phase III; SRG 2, B 6 layer 11, 5'6" (1292).

2. Terracotta; *obv.* compartmental geometrical design; *rev.* deep reed-mark; well baked, damaged; phase III; SRG 3, GX 10, layer 2, 2'5" (1833).

Pl. CLXII B

Terracotta; *obv.* Indus signs and unicorn with fire altar; *rev.* deep reed and cord marks; well baked; phase III SRG 3, GX 10, layer 2, 2'5" (1831).

Pl. CLXII C

1. Terracotta; *obv.* two impressions of a seal; Indus sign and unicorn with fire altar; *rev.* hollow depression; Ill-baked, damaged; phase III; unstratified, GX 10, layer 2, 2'5" (1984).

2. Terracotta; *obv.* two impressions of a seal; signs and unicorn with fire altar in the upper panel; *rev.* reed-mark; ill-baked, damaged; phase III; SRG 2, B 2, layer 3, 1'8" (722).

Pl. CLXII D

Terracotta; *obv.* two faint impressions of two Indus seals; *rev.* reed-mark; well baked; damaged; phase III, SRG 3, GX 10, layer 2, 3'4" (2077).

Pl. CLXII E

Terracotta; *obv.* three impressions of a seal; Indus signs and a unicorn with fire altar; *rev.* deep reed-mark; well-baked; damaged; phase III, SRG 3, GX 10, layer 2, 3'42 (1888).

Pl. CLXII F

Terracotta; *obv.* Maltese cross in a geometric frame; *rev.* reed mark; ill-baked, damaged; phase IV; SRG 2, GX 10, layer, unstratified, 3'4" (14586).

Pl. CLXIII A

1. Terracotta, *obv.* faint impression of Indus signs and unicorn with fire altar; *rev.* reed mark, well-baked, damaged; phase III; SRG 3, GX 10, layer 2, 2'62" (1877)

2. Terracotta; *obv.* Indus signs and bull with manger; *rev.* three deep reed marks; moderately baked, damaged; phase III, SRG 3, GX 10, layer 2, 2'6" (1879).

3. Terracotta; *obv.* Indus signs and unicorn with fire altar, *Rev.* Broad reed marks; half baked, damaged; phase III SRG 3, GX 10, layer 2, 3'4" (1898).

4. Terracotta; *obv.* Indus signs and unicorn with fire altar; *rev.* broad reed marks; half baked, damaged; phase III, SRG 3, GX 10, layer 2, 2'6" (1854).

Pl. CLXIII B

1. Terracotta; *obv.* Indus signs and horn of unicorn; *rev.* broad reed mark; well-baked, damaged, phase II-III, SRG 3, GX 10, layer 2, 3'1" (1880).

2. Terracotta; *obv.* Indus signs and unicorn partially visible; *rev.* reed marks; well baked; damaged, phase II-III, SRG 3, GX 10, layer 2, 2'6" (1926).

3. Terracotta; *obv.* Indus signs and unicorn head partially visible; *rev.* stick mark; half baked, damaged, phase IV, SRG 2, E 2, layer 4, 2' (3282).

4. Terracotta: *obv.* Indus signs and head of unicorn visible; *rev.* plain; half baked damaged; phase II-III; SRG 3, GX 10, layer 2, 2'6" (1876).

Pl. CLXIII C

1. Terracotta; *obv.* fire altar visible; *rev.* plain well baked; damaged; phase III; SRG 3, GX 10, layer 3, 3'22" (1855).

2. Terracotta; *obv.* Hind part of bull visible; *rev.* reed mark; well baked; damaged; phase III; SRG 3, GX 10, layer 3, 2' (1835).

3. Terracotta; *obv.* hind part of bull visible; *rev.* reed marks visible; over-burnt, flaking, phase III, SRG 3, GX 10, layer 3, 2' (1837).

Pl. CLXIII D

1. Terracotta; *obv.* Three impressions of a seal; Indus signs; *rev.* deep reed marks; not well-baked, damaged; phase III. SRG 2, B 1y, layer 3, 1'8" (3694).

2. Terracotta: *obv.* two impressions of a seal; Indus signs, *rev.* deep reed marks; well baked, damaged; phase III; SRG 2, E 2, layer 6, 3' (5242).

3. Terracotta; *obv.* two impressions of a seal; Indus signs, *rev.* reed mark; well baked. damaged, phase III; SRG 3, GX 10, layer 2, 2'6" (1883).

Pl. CLXIII E

1. Terracotta; *obv.* Indus signs faintly visible; *rev.* irregular; well-baked, damaged; phase II-III, SRG 3, GX 10, layer 3, 2'9" (1838).

2. Terracotta; *obv.* Indus signs faintly visible; *rev.* hollow reed mark; well-baked, damaged; phase II-III, SRG 3, GX 10, layer 3, 3'4" (1873).

3. Terracotta; *obv.* Indus signs, *rev.* reed marks; well baked, damaged; phase II-III, SRG 3, GX 10, layer 2, 2'6" (1853).

Pl. CLXIII F

Terracotta; *obv.* Four impressions of seals with Indus signs *rev.* deep reed mark; well baked; damaged; phase II-III; SRG 3, GX 10, layer 3, 3'4" (1895).

Pl. CLXIII G

Terracotta; *obv.* Five impressions of seals; recessed square all round; Indus signs faintly visible, *rev.* plain, well baked, damaged; phase IV; surface collection, (16845).

Pl. CLXIV A

Terracotta; *obv.* Indus signs and unicorn with fire altar; *rev.* plain; well baked; sling ball (?); damaged; phase III; SRG 3, J 5, layer 4; 2' (13881).

Pl. CLXIV B

Terracotta; *obv.* Composite animal with Indus signs; *rev.* flat pitted surface; phase III; SRG 2, BX 4 layer 2, 1'9" (13051).

Pl. CLXIV C

Terracotta; *obv.* Indus signs and unicorn; also textile impression suggesting use of cloth over wet clay before affixing the seal on it. *rev.* flat, with use-marks. phase III; SRG 2, A 1, pit sealed by layer 9, 4′6″ (800).

Pl. CLXIV D

Faience; *obv.* Bull and unicorn with trough and fire altar, and Indus sings- *rev.* Indus signs; phase III; (?) surface find (12352).

Pl. CLXIV E

1. Terracotta; *obv.* five impressions on two facets; Indus signs in four impressions and horn of unicorn in one; *rev.* cord and reed marks; well baked; damaged; phase III, SRG 3, GX 10.
2. Terracotta; *obv.* three impressions of Indus signs and head of bull; *rev.* deep reed marks; well baked; damaged; phase II-III, SRG 3, GX 10, layer 3, 3′4″ (1870).

Pl. CLXIV F

1. Terracotta; *obv.* Indus signs and horn of unicorn faintly visible; *rev.* flat; phase IV; SRG 2, surface find (15348).
2. Terracotta; *obv.* Indus signs: *rev.* Irregular; unbaked; phase III; SRG 3, surface find; (16912).

TABLE X

A—SEALS

Sl. No.	Antiquity No.	Material	Size	Remarks
1.	3017	Steatite	1.5″ ×1.5″	Intact.
2.	12277	Soapstone	0.62″×0.62″	Intact.
3.	5371	Copper	0.8″ ×0.8″	Intact.
4.	15263	Soapstone	0.9″ ×0.5″	Intact.
5.	14370	Steatite	0.9″ ×0.75″	Intact.
6.	10924	Shell	1.25″×0.82″	Damaged.
7.	3062	Terracotta	1.75″×0.75″	Intact.
8.	14875	Terracotta	1.5″ ×0.75″	Intact.
9.	15287	Terracotta	1.46″×0.6″	Damaged
10.	3269	Steatite	0.91″×0.32″	Intact.
11.	1258	Terracotta	0.5″ ×0.25″	Intact.
12.	4879	Steatite	1.25″×1.25″	Slightly scratched.
13.	407	Steatite	1.0″ ×1.0″	Broken.
14.	6726	Steatite	1.1″ ×1.1″	Intact.
15.	5450	Steatite	1.0″ ×1.0″	Intact.
16.	6492	Steatite	1.5″ ×1.5″	Damaged.
17.	8736	Steatite	0.62″×0.62″	Damaged.
18.	1758	Steatite	0.9″ ×0.9″	Damaged.
19.	5321	Steatite	1.5″ ×1.5″	Slightly damaged.

S. No.	Antiquity No.	Material	Size	Remarks
20.	4261	Soapstone	1.2″ 1.2″	Damaged.
21.	5397	Soapstone	0.8″ ×0.8″	Crude.
22.	989	Soapstone	1.0″ ×1.0″	Intact.
23.	6425	Soapstone	0.9″ ×0.9	Intact.
24.	15163	Steatite	1.4″ ×1.4″	Weathered.
25.	7341	Steatite	1.0″ ×1.0″	Intact.
26.	14976	Steatite	1.0″ ×1.0″	Damaged.
27.	15164	Steatite	0.75″×0.75″	Intact.
28.	4262	Steatite	0.9″ ×0.9″	Intact.
29.	9675	Steatite	0.75″×0.75″	Intact.
30.	16883	Steatite	1.0″ ×1 0″	Intact
31.	15462	Steatite	1.0″ ×0.88″	Damaged.
32.	17328	Steatite	0.75″×0.75″	Intact.
33.	17369	Steatite	0.75″×0.75″	Damaged and weathered.
34.	16767	Soapstone	1.25″×1.25″	Damaged corner and boss.
35.	15338	Steatite	1.4″ ×1.4″	Worn out.
36.	15333	Steatite	1.2″ ×1.2″	Damaged.
37.	5617	Soapstone	0.75″×0.75″	Damaged.
38.	14371	Soapstone	0.75″ ×0.5″	Damaged.
39.	14865	Steatite	0.7″ ×0.5″	Damaged.
40.	12028	Steatite	0.4″ ×0.4″	Damaged.
41.	11806	Steatite	1.5″ ×0.62″	Damaged.
42.	5958	Ivory	1.5″ ×1.5″	Worn out.
43.	8767	Soapstone	1.3″ ×1.3″	Damaged, probably meant to be re-used.
44.	12276	Steatite	0.75″×0.5″	Damaged.
45.	5625	Steatite	0.5″ ×0.5″	Damaged.
46.	5784a	Steatite	1.0″ ×1.0″	Broken.
47.	2899	Soapstone	1.0″ ×0.2″	Broken.
48.	1760	Steatite	1.1″ ×0.5″	Broken.
49.	13699	Steatite	1.6″ ×1.1″	Broken.
50.	5784b	Steatite	1.0″ ×1.0″	Broken.
51.	4829	Steatite	1.1″ ×1.1″	Intact.
52.	5040	Steatite	1.25″×1.25″	Intact.
53.	13388	Terracotta	0.75″×0.75″	Damaged due to over-firing.
54.	6947	Terracotta	1.6″ ×1.3″	Intact.
55.	9074	Terracotta	1.25″×1.0″	Intact.
56.	529	Steatite	0.6″ ×0.25	Damaged.
57.	15288	Terracotta	1.2″ ×1.0″	Intact.
58.	11358	Terracotta	0.85×0.85″	An example where the signs are below the motif Intact.
59.	6047	Soapstone	1.37″×0.75″	

S. No.	Antiquity No.	Material	Size	Remarks
60.	12923	Soapstone	1.25″×0.75″	Crude.
61.	2762	Soapstone	1.65″×0.5″	Intact.
62.	9989	Agate	1.20″×0.15″	Intact.
63.	3870	Terracotta	0.65″×0.55″	Broken.
64.	3453	Terracotta	1.0″ ×0.75″	Broken.
65.	1123	Terracotta	1.2″ ×0.75″	Intact.
66.	13017	Terracotta	1.6″ ×0.6″	Intact.
67.	15337	Steatite	0.86″×0.32″	Intact.
68.	15336	Steatite	0.86″×0.32″	Intact.
69.	4133	Steatite	1.25″×0.32″	Damaged.
70.	12341	Steatite	0.85″×0.38″	Intact.
71.	13004	Steatite	0.6″ ×0.5″	Broken.
72.	13994	Steatite	0.4″ ×0.2″	Broken.
73.	13732	Steatite	0.35″×0.25″	Broken.
74.	9716	Soapstone	0.8″ ×0.6″	Broken.
75.	6070	Steatite	1.1″ ×0.75″	Damaged.
76.	469	Soapstone	1.0″ ×0.5″	Damaged.
77.	3658	Agate	0.55″×0.5″	Broken.
78.	400	Terracotta	1.7″ ×0.75″	Damaged.
79.	5094	Terracotta	0.75″×0.75″	Damaged.
80.	1938	Terracotta	1.2″ ×1.2″	Damaged.
81.	4346	Terracotta	1.5″ ×0.75″	Broken.
82.	6184	Terracotta	1.6″ ×1.1″	Damaged.
83.	16845	Terracotta	0.66″×0.66″	Intact.
84.	17312	Terracotta	0.63″×0.63″	Corners worn out.
85.	17127	Steatite	0.62″×0.62″	Damaged.
86.	17171	Soapstone	0.5″ ×0.5″	Damaged.
87.	15976	Soapstone	0.66″×0.5″	Broken.
88.	6022	Steatite	0.75″×0.75″	Broken.
89.	2091	Steatite	1.1″ ×0.6″	Broken
90.	5262	Soapstone	0.5″ ×0.9″	Broken.
91.	769	Soapstone	0.16″×0.16″	Damaged.
92.	5008	Steatite	1.75″×0.75″	Damaged.
93.	3452	Yellow faience	0.5″ ×0.16″	Damaged.
94.	17199	Soapstone	0.87″×0.87″	Intact.
95.	13744	Soapstone	0.9″ ×0.9″	Intact.
96.	15264	Soapstone	1.0″ ×0.75″	Broken.
97.	9082	Steatite	0.6″ ×0.6″	Weathered.
98.	15031	Yellow Steatite	0.65″×0.65″	Weathered.
99.	15235	Soapstone	0.8″ ×0.8″	Intact.
100.	2421	Soapstone	0.75″×0.75″	Damaged.
101.	15339	Steatite	0.91″ dia.	
102.	13931	Terracotta	1.1″ ×1.0″	Intact.
103.	13941	Terracotta	1.2″ ×0.5″	Intact.

Sl. No.	Antiquity No.	Material	Size	Remarks
104.	15444	Steatite	0.6" × 0.35"	Damaged.
105.	17373	Steatite		
106.	17372	Steatite	Fragmentary (105–107)	
107.	17371	Steatite		
108.	14444	Steatite	0.6" × 0.35"	
109.	12833	Steatite		
110.	1199	Soapstone	Fragmentary (109–114)	
111.	9675	Steatite		
112.	4186	Soapstone		
113.	2417	Terracotta		
114.	761	Terracotta		

TABLE XI

SEALINGS

Sl. No.	Antiquity No.	Material	Size	Remarks
1.	13191	Terracotta	1.75" × 1.0"	Damaged.
2.	1830	Terracotta	1.8" × 1.6"	Damaged.
3.	1292	Terracotta	2.5" × 2.0"	Damaged.
4.	1893	Terracotta	2.13" × 1.5"	Damaged.
5.	1831	Terracotta	1.36" dia.	Undamaged.
6.	1984	Terracotta	2.75" × 2.5"	Damaged.
7.	722	Terracotta	2.52" × 1.75"	Damaged.
8.	1888	Terracotta	1.85" × 1.35"	Damaged.
9.	2077	Terracotta	3" × 3"	Damaged.
10.	14586	Terracotta	1.55" × 1.0"	Damaged.
11.	1877	Terracotta	1.4" × 1.2"	Damaged.
12.	1879	Terracotta	1.1" × 0.9"	Damaged.
13.	1898	Terracotta	1.9" × 1.0	Damaged.
14.	1854	Terracotta	1.5" × 0.75"	Damaged.
15.	1880	Terracotta	1.5" × 0.75"	Damaged.
16.	1926	Terracotta	1.4" × 1.0"	Damaged.
17.	3292	Terracotta	0.5" × 0.75"	Damaged
18.	1876	Terracotta	1.5" × 1.1"	Damaged.
19.	1855	Terracotta	2.5" × 2.2"	Damaged.
20.	1835	Terracotta	1.82" × 1.25"	Damaged.
21.	1837	Terracotta	2.0" × 2.0"	Over-burnt, peeling.
22.	3694	Terracotta	1.25" × 0.75"	Damaged.
23.	5242	Terracotta	0.75" × 0.5"	Damaged.
24.	1883	Terracotta	0.75" × 0.5"	Damaged.
25.	1838	Terracotta	1.75" × 1.25"	Damaged.

Sl. No.	Antiquity No.	Material	Size	Remarks
26.	1873	Terracotta	1.0″ ×0.75″	Damaged.
27.	1853	Terracotta	1.5″ ×1.5″	Damaged.
28.	1845	Terracotta	2.2″ ×1.2″	Damaged.
29.	1870	Terracotta	2.1″ ×1.0″	Damaged.
30.	16845	Terracotta	2.4″ ×1.11″	Damaged.
31.	13051	Terracotta	2.0″ dia.	
32.	800	Terracotta	0.95″ dia.	-do-
33.	12352	Faience	1.0″ ×0.5″	-do-
34.	13881	Terracotta	2.5″ ×2.5″	Sling ball, damaged.
35.	15348	Terracotta	1.32″×1.25″	Undamaged.
36.	16912	Terracotta	1.75″×0.62″	Damaged.
37.	6742	Terracotta	2 1/4″×1¼″	Sling ball, damaged.
38.	8738	Terracotta	2″ × 1″	
39.	3466	Terracotta	2.5″ ×1.25″	Damaged.
40.	1990	Terracotta	1.75″ ×1″	Damaged.
41.	2093	Terracotta	1.16″×1.5″	Damaged.
42.	1842	Terracotta	1″ ×3.75″	Damaged.
43.	1832	Terracotta	2.5″ ×1.5″	
44.	1843	Terracotta	.5″ ×1.5″	Damaged.
45.	1841	Terracotta	2″ ×1.6″	Damaged.
46.	1886	Terracotta	2″ ×1.5″	Damaged.
47.	1850	Terracotta	1.5″ ×1.16″	
48.	1823	Terracotta	.5″ ×.6″	Fragment.
49.	1872	Terracotta	1.75″×.5″	Broken.
50.	1849	Terracotta	1.5″ × 1″	Damaged.
51.	1871	Terracotta	.5″ × 1″	Damaged.
52.	1868	Terracotta	2″ × 1″	Damaged.
53.	1847	Terracotta	1.75″× 1″	Damaged.
54.	1869	Terracotta	1.5″ × 1″	Damaged.
55.	1864	Terracotta	1.5″ × 1.16″	Damaged.
56.	1863	Terracotta	1.5″ × 1″	Damaged.
57.	1861	Terracotta	2″ × 1.16″	Damaged.
58.	1862	Terracotta	1″ × 1.5″	Damaged.
59.	1856	Terracotta	1″ × .75″	Damaged.
60.	1887	Terracotta	1.5″ × .75″	Damaged.
61.	1866	Terracotta	1.5″ × 1.5″	Undamaged.
62.	1836	Terracotta	1¼″ × 1″	Damaged.
63.	1865	Terracotta	1.25 × 1″	-do-
64.	1846	Terracotta	1 .6″ × 1″	-do-
65.	1852	Terracotta	1″ × .5″	-do-
66.	1884	Terracotta	1.5″ × 7.5″	-do-
67.	1851	Terracotta	2.5″ × 2″	-do-
68.	1857	Terracotta	3″ × 1.75″	-do-
69.	1885	Terracotta	1.8″ ×1″	-do-
70.	1898	Terracotta	1.5″ × 1″	-do-
71.	1881	Terracotta	2″ × 1.5″	-do-

Sl. No.	Antiquity No.	Materials	Size	Remarks
72.	1889	Terracotta	2″ × 2″	-do-
73.	1848	Terracotta	2″ × 1.5″	-do-
74.	2498	Terracotta	1.25″ × 1″	-do-
75.	1891	Terracotta	2″ × 1.25″	Unbaked.
76.	1928	Terracotta	1″ × 1″	-do-
77.	1844	Terracotta	1.5″ × .25″	-do-
78.	1875	Terracotta	2″ × 1½″	Heavily damaged. Unbaked.
79.	1941	Terracotta	1″ × 1″	Heavily damaged.
80.	1983	Terracotta	2″ × 1.5″	Damaged.
81.	2228	Terracotta	10.4″ × 1″	-do-
82.	1924	Terracotta	1.5″ × 1″	-do-
83.	4302	Terracotta	.5″ × .75″	Unbaked, damaged.
84.	1759	Terracotta	1.5″ × .75″	Damaged.
85.	2059	Terracotta	2″ × 1¼″	-do-
86.	2076	Terracotta	1.5″ × .9″	-do-
87.	1839	Terracotta		
88.	1882	Terracotta		
89.	1874	Terracotta	Fragmentary	
90.	1927	Terracotta		
91.	3746	Terracotta		

CHAPTER XVII

THE POTTERY

1. INTRODUCTION

Lothal occupies an important place in the study of the ceramic art of the Indian sub-continent in the protohistoric period as it has forged new links with the post-Harappan chalcolithic cultures by evolving a new ceramic ware from the degenerate Harappan wares as in Rangpur[1]. In view of the frequent references in this report to the ceramic evidence from Rangpur it may be noted here that Rangpur IIA is equated with the middle and late levels of Lothal A and Rangpur IIB and IIC with Lothal B, the only difference being that the evolved ceramic wares of Lothal B do not have a lustrous red surface as in Rangpur IIC. Neither the new technique of surface treatment noticed in Rangpur IIC nor the exuberance of the Lustrous Red Ware noticed in Rangpur III is encountered in Lothal B.

The ceramic wares of Lothal A can be broadly divided into two groups namely, the Harappan Wares and the Associate Wares, the former comprising the Red Ware,[2] the Buff-slipped ware, the Buff Ware, the green ware and the grey ware, all of which are sturdy and made of fine clay. Both in form and surface-treatment they are identical with the red and grey wares of the Indus Valley. Generally the fabric of all these wares is thick and sturdy but some vessels are thin. Occasionally the red ware is chocolate-slipped, but is often painted in crimson, black and rarely in white. The Buff-ware and buff-slipped ware are painted in black or chocolate. The second group chiefly consists of the black-and-red ware and the Micaceous Red Ware, both made of fine clay. Both the groups continue to occur in small quantities in Period B, but again new forms are evolved and the fabric is coarse. A new ware found at Prabhas and christened as 'Prabhas Ware' by late Shri P.P. Pandya occurs in Lothal B in small quantities. Besides these two groups the grey and red wares of coarse fabric also occur here. Ceramic wares of a distinctly foreign origin found in small quantities are included among the Associated Wares as they provide valuable evidence for cross-dating. They are painted white on black, chocolate on buffish yellow or black on pink. Some are treated in the reserved slip technique. The Archaeological Chemist has examined all the fabrics in detail (below p. 461 ff.).

Lothal provides the missing link between the chalcolithic cultures of Central India and the Deccan on the one hand and the Harappa Culture on the other in the form of the black-and-red ware which occurs in small quantities in all the phases of occupation. Analogous forms such as the bowl with or without handle and basin are noticed in the Micaceous Red Ware which, together with the coarse red and grey wares, formed the ceramic equipment of the indigenous folk whom the Harappans met on their arrival in Kathiawar.

Another important contribution of Lothal is that it developed a new style of painting known for its realism and grace uninhibited by the conventionalism of the Harappan style

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[1] S. R. Rao *Ancient India* 18-19; 1963, pp. 20-27.

[2] Capitals are used in the case of the Harappan Red Ware, Buff Ware, and Buff-slipped Ware to distinguish them from other red and buff wares of coarse fabric from Kathiwar and Central Indian sites.

which also flourished side by side. As a provincial variant the new style enriched the Harappa Culture in its mature phase.

A. Material

(i) Clays

The natural soil available in the flood plains around Lothal is alluvial clay mixed with small quantities of mica. Below this deposit is a thicklayer of whitish *kankar* the nodules of which form a natural impurity responsible for the buff colour of the Harappa Wares (below p. 462-3) when fired and imperfectly oxidised. The alluvial clay is capped by a deposit of sticky black clay which is used nowadays for pottery-making. The Lothal potters, however, used mostly the fine alluvial clay to produce sturdy vessels. No special effort appears to have been made to levigate it further. A considerable number of vessels of the post-Harappan period from Rangpur and Lothal B which were produced from black clay are coarse. An experiment conducted recently has revealed that pots produced by the local potters from the buffish alluvial clay are finer in fabric than those produced from black clay, although the technique of firing and tempering adopted by them in both the cases was the same.

The formation of black clay in Lothal-Rangpur region is said to be partly due to stagnation of water for long periods and partly to humus. In any case, black clay cannot be said to have been formed as a result of the weathering of the rock *in situ,* for no rock is seen on surface anywhere within a radius of fifty miles from Lothal. Sometimes coarse vessels, grey or red in colour, were produced by adding grit to black clay.

(i) Tempering material

Mica, sand and lime occuring in small quantities as natural impurities acted as *degraissants* for tempering earthen wares. However, in the case of coarser wares, sand, lime and chaff were deliberately added to counteract the plasticity of black clay for producing a porous and gritty surface.The use of chaff in clay for producing red and coarse grey wares is evident from the smoky core and pitted surface and section of the vessels. Occasionally, animal-dung was also used as a *degraissant.*

B. Technique

(i) Throwing

The majority of the vessels from Lothal are wheel-turned, but hand-made ones are not altogether wanting.

Small jars, vases, goblets, beakers, bowls, dishes, basins and other miscellaneous pots were directly turned on a fast wheel as can be made out from the close and regular striations noticed on them. In many a case, marks of thread or hair used for removing the pots from the wheel are clearly seen on the base. That the potter had an excellent control of the wheel is borne out by the sophisticated forms of vessels produced by him. Among vessels which were turned on the wheel in separate parts and subsequently luted are the dish-on-stand, the ribbed jar, the ring-footed vase and the bowl with a stud-handle. Luting was done so carefully that the joint is hardly visible. Such vessels however break at the junction.

Large storage jars were given in the first instance a rough and thick shape on the wheel and subsequently beaten to their final shape with the help of a dabber as is the case even today at Rangpur. Fine sand and ash were constantly sprinkled on the surface of the jar to keep it dry in the course of beating. Finally, the surface was smoothened by hand using a thin solution of the clay. In such cases striations are not noticeable.

(ii) Modelling

Hand-made pottery mainly consists of miniature vessels. Except in a few cases they are so crudely modelled that the workmanship is attributed to children especially because they were used as toys. Larger hand-made vessels are found to have been modelled simply with the help of fingers and rarely an instrument such as the knife has been used for trimming etc. Among the hand-made utilitarian vessels cups, lamps, dough plates and bowls are important. Large storage jars were prepared by the coiling-and-beating method.

(iii) Slips

The bulk of the Harappan and Associated Wares of superior fabric from Lothal is found to have been treated with a thin slip of red, chocolate or orange colour. The slip on the vessels from Harappa and Mohenjo-daro is generally darker and thicker than the one noticed on most of the vessels from Kathiawar. Some of the Red Ware vessels from Lothal elaborately painted in the characteristic Harappan style are however treated with a thick dark red slip. Occasionally, two slips overlapping in the central register are also applied. The colour scheme consists of red and buff or chocolate and red. In a few instances a chocolate or red slip is applied over the buff surface of the vessel. It appears that the pigments were mixed in a clay solution to the required consistency so as to see that the thermal expansion of the slip did not differ greatly from that of the body clay when heated. The slip thus prepared was applied with a brush, rag or cotton-piece when the pot was leather hard and then rubbed with a burnisher to produce a smooth, shining surface.

A red-ochre slip is found to have been applied over the Red Ware and the Micaceous Red Ware, but rarely on the coarse red wares. Occasionally, a thin secondary coating seems to have been given over the buff ware and buff-slipped ware.

The Micaceous Red Ware vessels are treated with an orange slip and burnished to produce a smooth shining surface. Patches of red, buff and pinkish slips noticed on some pots and various shades of yellow, red and orange occuring on others may be due to the presence of iron compounds in the clay or due to differential firing. Sometimes the effect of a slip is produced by merely applying a thin solution of clay and burnishing the surface.

A buff-ochre slip made of earth-colour was often applied on the Red Ware, and occasionally on the Buff-Ware too. The application of red slip over a buff slip produced a chocolate effect.

There are a few instances of a black or grey slip having been rubbed well into the body of the vessels of a superior grey ware. It is however clear that the vessels were burnished and and subsequently fired under reducing conditions.

A chocolate slip is noticeable on some vessels of the Red Ware as well as the Buff Ware groups.

(iv) Wash

Red and Buff Ware vessels were frequently given a thin wash of red or yellow ochre, the solution being too thin to cover the striation marks, and the wash is easily removed.

A large number of vessels of all categories except the Micaceous Red Ware are not treated with any slip or wash.

(v) Firing

The uniformly-burnt sections of the vessels in the Harappa Wares and the Micaceous Red Ware suggest that they were fired at a high temperature under controlled conditions. Even the thick storage jars appear to have been fired in kilns where temperature could be controlled. The vessels thus fired are sturdy and produce a metallic sound when struck. Partial oxidisation of certain portions of the vessels indicates a limited supply of oxygen in the kiln in some cases.

Although the Buff Ware and Red Ware are not the result of firing under different conditions, it is the presence of lime in the clay used for the former that produced the buff colour. The coarse grey ware was fired under reducing conditions and the black-and-red ware partly under reducing and partly under oxidising conditions.

(vi) Kilns

Three types of kilns have been laid bare in the excavations. One of them is almost circular; the second is ovoid and the third is rectangular, on plan, but it is doubtful whether any of them was used for firing pots. The kiln located near the bead factory is 6 ft. in diameter and has a furnace below a perforated floor. Fuel was supplied through a stoke-hole opening on the north and fire was confined to the lower chamber. Heat reached the upper chamber through four interconnected flues and these openings were found covered with bricks. The circular wall of the upper chamber is 8 inches thick. In Western Asia similar kilns with thicker walls of mud had a domed roof with a central opening for allowing smoke to escape. Such kilns are useful in graduating heat according to requrement, in effecting economy of fuel and in avoiding direct contact with fire. Closed kilns have been found at Mohenjo-daro as well as Jamdet-Nasr.[1] Perhaps Lothal potters also used closed kilns for pottery-baking (fig. 11, 3). The small kiln found in Block E is ovoid on plan and has rectangular base of a pier in the centre. This type of kiln was suited for making glazes and beads of faience etc., provided it had a dome with a central pipe. The third type of kiln noticed in 'B' block is rectangular on plan and had a vaulted roof (pl. LXXI, B). Two compartments, one by the side of the other, have been traced partially. The burnt floor and walls suggest that the structure was used as a kiln. Square kilns are known from Susa D,[2] and Kish,[3] the latter being dated *circa* 2800 B.C.

2. MAIN CERAMIC TYPES

In addition to the normal Indus types Lothal has yielded some new ceramic types unknown in the Indus and Ghaggar Valleys. A brief description of the more significant types and their possible use are given below.

A. JAR

Storage jars with walls varying in thickness from 1/2 to 3/4" occur in the Red Ware and the Buff Ware throughout Period A and are more numerous in phases II—IV. They

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[1] Mackay *Further Excavations at Mohenjo-daro* 1938, I, p. 171

[2] D. Morgan (ed) *Delegation en Perse, Memoires XX* (Paris, 1900) fig 16

[3] Mackay *Authropology Memoires* (Chicago) I, pp. 115-116

are found in small numbers in an inferior fabric in Period B also. The shape varies from bulbous to a concavo-convex profile, the base being flat and narrow. On an average the jars are 1 ft. 6 inchs. to 2 ft. 3 inchs. in height and 1 ft. to 10 inchs. in diameter. They were built up by adding successive tiers of clay bands. In a few instances the rim or bottom or both were turned on the wheel and subsequently joined to the body. The smaller jars were wholly prapared on the wheel. A few of them were painted with simple horizontal bands on the rim and shoulder in black over red or chocolate over a buff back-groud. Occasionally, the shoulder or the lower part of the jar shows an impressed cord design.

The jar with a wide mouth, splayed rim, ledged neck, globular body or convex profile and a narrow flat base is a popular type (fig. 39A, *1* to *3*) in the early and middle levels of Period A, gradually decreasing in number in the late levels. This type is confined to the Harappan wares and is rare in Period B. Another form of the storage jar has a wide mouth, projected rim, receding sides and a narrow flat base (fig. 39B, *4b* and *4c*). The thick rectangular section of the rim is clubbed in Period B (fig. 84, *264a*).

The third type has a narrow mouth, projected rim, globular body and flat base (fig. 44, *14b*). It occurs in the Harappa wares and survives in Period B when the rim is found to have been beaded (fig. 84, *268*). A tall 'S'—shaped vessel with a flanged rim, flat or concave base and a concavo-convex profile occurs in the middle and late levels of Period A in Red and Buff Wares but disappears in Period B. It is characteristic of all Harappan sites and some vessels of this type are elaborately painted (fig. 41, *9*). This type is found to be squattish in later levels of Period A. The jar of medium size with a short flaring rim and round body (fig. 68, *181*) is confined to the Micaceous Red Ware. The variants are painted in black oblique lines enclosed by horizontal bands and zigzags on the shoulder with a fine brush. They decrease in number but the neck gets elongated and rim projected in Period B (fig. 86, *277b*). The majority of large jars in superior fabric must have been used for storing grain etc., while some in coarse fabric were however used as soakage jars and dyevats.

A large 'S' shaped vessel of Red Ware painted in black all over the surface in horizontal registers and vertical panels with geometric and naturalistic designs and found placed near a brick-built fire altar (fig. 42, *9a*) was apparently used for a ritualistic purpose. Three other jars with a convex profile found in the courtyard of a house but not elaborately painted appear to have been used for storage of grains or liquids. An interesting type among small jars of thin fabric is one with a small neck, beaked or beaded rim, globular body and flat base (fig. 43, *13a*). The beaded rim is more prominent in phase IV and the neck is also slightly raised. It is interesting to note that this type is evolved into a high-necked jar with a beaked rim in Period B (fig. 79, *234*). It develops a sagger base and ovoid body in Rangpur IIc and III.

The jar with a splayed-out rim, ribbed shoulders and sagger base (fig. 55, *87* g) occurring in Red and Buff Wares is another characteristic Harappan type noticed at Lothal. Some variants are squattish and carinated below the shoulder. The upper surface is treated with a red or chocolate slip and occasionally burnished, and the lower part is usually unslipped but given a buff wash. An imitation of this type is noticed in the coarse red ware (fig. 70, *195*) from the middle level of Period A. An analogous type in alabaster from Khafaje lying in the Baghdad Museum is referred to by Mackay.

The small jar with a flaring rim, globular body and rounded base noticed in the Micaceous Red Ware (fig. 68, *181a* to j) and the coarse red ware (fig. 70, *191*) in Period A is an indigenous type which continues even in Period B (fig. 86, *277*). The neck is raised in a few cases (fig. 86, *277b*). The Micaceous Red Wares jars are painted in black over an

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[1] S, R. Rao *op. cit*, 1963, fig. 16, *1* to *5* and fig. 41, *75*.

orange or a pinkish-brown slip with zigzags enclosed by horizontals or with wavy lines and loops on the shoulder. The occurrence of similar types painted with zigzags, horizontals and loops in the pre-Harappan levels at Kalibangan is highly significant. The Micaceous Red Ware occurring 10 ft. below the present water table in SRG 30 might represent a pre-Harappan occupation at Lothal (below p. 393). Being very handy, they might have served as water-pots. Larger jars of this type in coarse red and grey wares were probably used for cooking purposes. Some vessels from the pre-Harappan levels at Kalibangan are comparable with above mentioned type in the Micaceous Red Ware from Lothal. Almost all the Harappan sites are noted for the tall cylindrical jar with a wide mouth, projected rim and perforated walls (fig. 45, *26* to *26d*), which occurs at Lothal in the Red Ware. A few are found in the Buff Ware also. The perforated jar has a rounded or flat base and some miniature imitations have a pedestal base. The walls are perforated at close intervals with a thick sharp stick or nail of round section. A large hole is also noticed in the bottom except in the case of a few miniature jars. Sometimes the larger vessels were painted with wide horizontal bands in red and buff colours. This type was very popular in phases II and III as is the case with most of the other ceramic types characteristic of mature Harappa Civilization in the Indus Valley. An imitation of the perforated jar is found in the Micaceous Red Ware and the coarse red ware also. The use to which this type of vessel was put is a matter of speculation among the archaeologists. Sir Aurel Stein found a perforated jar full of charcoal in a Harappan site in Makran and therefore designated it as a heater. This term, was adopted by many scholars including Marshall, Vats and Wheeler. During the present excavations special care was taken to examine the contents of the perforated jars in their *in situ* position with a view to see if their exact use could be determined. It was observed that not a single perforated jar from Lothal or Rangpur was found to contain charcoal or ash, nor was any smoke mark noticed in any of them. One of the suggestions made is that it was used for pouring water in *avabhrita snāna* (sacred bath) during a sacrifice.

B. Vase

A tall water jug or vase with an ovoid body and pedestal base (fig. 46, *29* to *30b*) was in common use in the Indus Valley sites. This plain Harappa ware makes its first appearance in phase II and disappears in phase V. Even today water containers of this type in metal are popular in Gujarat. It is doubtful if it was used as a flower pot.

C. Goblet

Another Harappan type found at Lothal is the goblet (fig. 46, *31*) in Red and Buff Wares. Its surface is plain and often unfinished. The scoured goblet with a pointed base (fig. 46, *33a*) is extremely rare at Lothal and occurs only in the late levels of Period A. At Harappa also it is popular only in the late levels. A variant of the goblet of this type has a less-pointed base (fig. 46, *32* and *32a*) while another with an elon- gated neck is more like a vase than a goblet (fig. 46, *30a*) and was more popular in phases III and IV. The non-occurrence of the goblet in Period B at Lothal is highly significant. In Rangpur, too, the goblet was absent in Period IIc. The bottom of the Indus valley goblet is often too narrow for the pot to stand by itself. It must have been supported by a separate stand. It is doubtful whether the goblet was placed in the central hole of the dish-on-stand. Probably the goblets were used for drinking wine or water while the dish contained eatables.

D. Beaker

Among other Harappan types found at Lothal the beaker (fig. 46, *35*) occupies an important place. It is a small, more or less cylindrical, pot with a flaring rim and flat base. Being very handy it must have been used for drinking any liquid. In North India, tea and milk are served even now in such clay vessels, but are thrown away once they are used. The beaker was in use throughout Period A and gradually disappeared in Period B at Lothal. The interior of the vessel is sometimes corrugated on account of the pressing of the fingers while the vessel was on the wheel. Marks of string used for removing the vessel from the wheel can be seen on the base.

E. Dish-on-stand

This unique Harappan type described by some as an offering stand was in common use at Lothal throughout Period A and underwent some modifications in Period B. It is made in two pieces on the wheel, the stem and the base forming one part and the pan the other. The base of the dish was secored all over to make the stem adhere to it more readily and the joint was in most cases very carefully concealed by luting with clay on the exterior. Except in the burials the dish-on-stand is not found anywhere intact. Two types of stands, one with mouldings and the other without, can be made out. It is, however, difficult to determine the shape of the dishes attached to different types of stands. The dish-on-stand with a long plain stem (fig. 58, *99*) was more common than the one with a moulded stem (fig. 47, *39* and fig. 96, *9*). Another type of dish-on-stand has a squat broad stem and is often painted. It was more popular in Period B (fig. 81, *242*) than in Period A (fig. 47, *38*). This types underwent modifications in Period B when the stand gets broader but squattish and beaded at the base (fig. 81, *242* and *245*) whereas the dish loses its carination and the rim is beaded (fig. 81, *247a*). Further evolution is noticed in Rangpur IIc and III.[1]

The medium-sized stand (fig. 47, *37*) found at Lothal deserves special mention. The dish-on-stand with a ball-like moulding at the top of the stem is well finished with a thick red slip and the surface is wetsmoothed. Originally it carried a thick dish similar to the one noticed in the cemetery (fig. 96, *9*). This type was popular in phases III and IV but not in phase V. The dish-on-stand with a squattish broad stand and large dish occurring frequently in the late levels of Period A (fig. 47 *38*, *38a* and *38b*) in the Red and Buff Wares and also in Period B (fig. 81, *242 243* and *245*) is sturdier than the dish-onstand with a long stem. The purpose of having a large hole in the centre of the dish in some cases is not understood (fig. 81, *242*). Normally, the dishes are treated with a thick red slip and the painting consists of horizontal bands, cross-hatchings etc. The rim is often projected with a carination at the shoulder in Period A, but non-carinated and short in Period B. It is highly significant that the small dish-on-stand of Period A (fig. 48, *42g* and *42i*) develops into a footed bowl in Period B (fig. 80, *240*). The evolution is however clearer in Rangpur IIc and III[2] where the Harappa culture as a whole is transformed into the Lustrous Red Ware culture. The bowl with a short stem at Lothal (fig. 47, *38d*) in the late levels of phase IV is the fore-runner of the stemmed bowl or wine cup of Rangpur IIc and III. In a few instances the shallow dishes with an incurved rim bear marks of luting with the stem which was perhaps long and narrow (fig. 48, *43a*). This type of dish-on-stand does not undergo any significant change. Another type of dish-on-stand found in large numbers in the late levels of Period A has a

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[1] S. R. Rao *op cit*, 1963, fig. 17

[2] S. R. Rao, *op. cit*, 1963, fig. 17, pp. 27 to 31.

thick dish with an everted or beaked rim, carinated shoulder, and occasionally the interior is ledged. It occurs mostly in Red and Buff Wares and is frequently painted with horizontal bands, intersecting loops, hatched triangles etc. A sub type of the same occurring in early levels is not carinated although the rim is beaked and everted. The type of stand these dishes originally had is not known but later ones were supported by broad squattish stands.

The sturdier dishes of Period B have their origin in phase IV of Period A itself. They undergo a gradual change in shape by the blunting of the beaked rim and the disappearance of the carination at the shoulder resulting in dishes with featureless or beaded rim and non-carinated shoulder. Although the fabric is not as sturdy as in phase II the slip and painted designs are more or less the same. In the next stage this type is found to have been evolved into a dish with a beaded rim in Rangpur IIc.[1] It is difficult to say precisely the purpose which the dish-on-stand served. It could be used as a fruit-stand, or an offering-stand or as a dish for eating meal while sitting.

F. Dish

Apart from the dish-on-stand a large number of shallow dishes are found at all the Harappan sites. At Lothal the dishes with an incurved beaded rim and a round or flat base (fig. 49, *49f* to *49m*) occur throughout Period A almost disappearing in Period B. Most of the sturdier ones occur in phases III and IV and are painted in black over a thick red or buff slip. A few are however severely plain. In the earlier levels they are thin and have a nail-headed rim. A deep dish with a flat base and raised edge is noticed in the late levels of Period A but disappears in Period B. It is a rare type confined to the red ware and can be used for keeping liquid or semi-liquid food.

G. Basin

Four types of basins are found at Lothal. One of them having a narrow flat base, tapering sides and incurved rim (fig. 50, *51*) occurs in phases II, III and IV but not in phase V. It is normally unslipped and resembles more or less the *kunda* of the present day. The more popular basin of Period A has a flaring or projected rim and slightly carinated shoulder (fig. 50, *52*). It develops a flat projected rim and convex or straight sides in the late levels. These two types of basins in Red and Buff Wares are unpainted but well-slipped all over the surface except at the base. Another type has a projected rim, concave sides and a carinated shoulder (fig. 51, *53d*). The fourth type has straight or convex sides, a flat base and featureless rim (fig. 51, *56* and *59*). It is generally slipped in wide bands of red at intervals over a buff background and occurs mostly in phase IV. A deep dish could as well have served the purpose of a basin. The basin-cum-dish (fig. 51, *60*) is an example of this kind.

H. Bowl

(i) Bowl without handle

One of the most common ceramic types in use at the Harappan sites in Kathiawar is the convex-sided bowl in which two important sub-types may be noted here. It is an indigenous type initially produced in the Micaceous Red Ware before the advent of the

[1] S. R. Rao *op. cit*, 1963 fig. 34, 38 to 40

Harappans but soon copied in the Red and Buff wares of sturdy fabric. The Micaceous Red Ware is predominant in phase I while in the subsequent phases the Red Ware and Buff Ware (Harappan wares) are more popular. The bowl in the Micaceous Red Ware (fig. 69, *187*) has a round base while the one in the Red Ware (fig. 52, *64*) has a flat base. A bowl in Buff Ware (fig. 60, *113*) is suspected to have had a rounded base. But all of them have a featureless rim and convex sides and are treated with a slip. They are frequently painted in black or chocolate over a red, pink or buff slip with horizontal bands, enclosing zigzags or a criss-cross pattern, and inverted loops, on the exterior and with hatched diamonds, ladders etc. on the interior. The first sign of evolution into a straight-sided bowl is seen in phase IV (fig. 52, *64b* and *64c*). Further changes took place in phase V when the shoulder became blunt-carinated (fig. 83, *256b* to *257c*) as in Rangpur IIc.[1] The buff-slipped bowls are occasionally painted with horizontal bands in chocolate. The round bottomed bowls with convex-sides are noticed in the black-and-ware and the Micaceous Red Ware but rarely in coarse grey and coarse red wares. The bowls and jars with rounded base do not occur sites in the Indus Valley and may therefore be considered as Kathiawar types.

It may noted here that non-carinated bowls continue to occur in Period B, although blunt-carinated bowls were already evolved. Further changes in the form of these bowls are noticed in Rangpur III where sharp carinated bowls were evolved. Another type in the Micaceous Red Ware confined to Kathiawar Harappan sites is a bowl with-an out-turned rim, convex sides and round base (fig. 68, *185a*) In treatment of surface and painting it compares favourably with the convex-sided bowls of the Red Ware, but makes its first appearance in phase III and continues in phases IV and V. It is also found in the black-and-red ware. The round-bottomed bowl with convex sides and featureless or out-turned rim and the high-necked jar of *lota*-shape were frequently used for funerary purposes (fig.96, *3, 6, 10* and *11*)

(ii) Bowl with handle

This is a unique type of bowl exclusively found at the Harappan sites in Gujarat. It is almost similar to the convex-sided bowl with a round base in the Micaceous Red Ware but has, in addition, a vertical stud-handle to hold it (fig. 69, *188* and fig. 75, *A 51*). Its surface is smooth and painted in black over an orange, or light-red slip with hatched diamonds on the interior and horizontal bands on both the surfaces of the rim. Often the handle is also painted on top with intersecting lines enclosed by a circle. This type evolves a long handle in Period B (fig. 86, *280* and *280a*). The elongation starts in phase IV itself, when the bowl tends to be larger and thicker. The occurrence of a bowl with a stud-handle in the black-and-red ware (fig. 73, *225*) at Lothal clearly indicates that vessels could be fired under fully oxidising conditions producing a red ware or under partly-oxidising and partly-reducing conditions to produce the black-and-red ware. Hence inverted firing is not a culture trait but only a technique of firing which was known in Gujarat, perhaps even before the Harappans arrived here. The occurrence of distinct ceramic types such as the jar with round bottom and flaring rim, the convex-sided bowl with or without a stud-handle in the Micaceous Red Ware and of the painted black-and-red ware vessels, all of which are unknown in the Indus Valley suggests the existence of an indigenous culture at Lothal before the advent of the Harappans. Further, the preponderance of the

[1] S. R. Rao *op. cit.* 1963, fig. 33, 12-14.

[2] *Ibid* fig. 39, *46-59.*

non-Harappan wares in the earliest levels is a positive indication of a pre-Harappan occupation at Lothal.

I. Handled cup

A cup with a perforated lug-handle and pedestal foot (fig. 52, *66*) encountered at Lothal in the Harappan Wares in Period A occurs in the Indus valley sites also. The vessel is hand-made and plain.In the absence of any smoke-mark or any lip for the wick to rest, it is difficult to accept the view that these cups were used as lamps. In fact the lamps of Periods A and B are distinct and have necessary provision for wick.

.J Lamp

Four types of lamps are found at Lothal in the Red Ware as well as the Micaceous Red Ware. The first type (fig. 69, *189* and *189a*) has an oblique or flat-cut rim, round bottom and pinched projecting lip for the wick. It is painted on the rim with horizontal bands and on the interior of the walls with intersecting lines. A variant of this type has a sharp rim, but both bear marks of soot. It is interesting to note that lamps with obliquely cut rim and round base occur in Enkomi, Jericho[1] and Mersin[2] but not in the Indus valley. There is but one example of a lamp from phase IV of a second type of lamp which is ovoid on plan and has a perforated pinched ear. It is hand-made and rough. A thick wick in the form of a cotton-piece was probably kept in the centre on a pebble, as is done even now in India. This gives more light than the first type mentioned above.

Another type or lamp found at Lothal is circular on plan and has a flat base with three concentric circular walls with deep grooves in between for retaining oil (fig. 61, *123*). Traces of the cross pieces joining the concentric walls are also visible. The soot-marks on the rim of the wall of the central chamber suggest that a wick was burnt here. Lamps of smaller size in this type found in phase IV are hand-made. None of them is painted but a buff wash was given. The conspicuous absence of this type of lamp in the Indus valley and its occurrence at Ur suggest that Lothal had contact with Ur. The fourth type has a round base and incurved rim (fig. 83, *259* and *260*). It is found in Period B at Lothal, in Rangpur IIc and III,[3] Rojdi IB[4] and in the Indus valley sites. It has a channel for the wick, and the rim is painted across with black bands.

K. Lid

Among the few lids found at Lothal four types can be distinguished. The most common lid has a flat base and tapering sides with or without a knob in the centre (fig. 52, *71*). It occurs at Harappa, Mohenjo-daro and Lothal. The second type is almost like a bowl with a featureless rim (fig. 52, *72*) and a central knob in some cases. The third type occurring in phases III and IV has an external knob and the rim is flanged to fit into the mouth of the pot properly (fig. 53, *73*). Many lids of large size are found damaged. A lid with a hole in the projected rim (fig. 53, *73a*) might have been used on a S-shaped vessel and secured with lashings as can be judged from S-shaped jars (fig. 42, *9b*) with a corresponding hole in the neck. For purposes of transporting liquids pots with flanged rim

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[1] C.F.A Schaeffer, *Stratigraphie Comparee et Chronologic de l'Asie Occidentale* (Lond. 1948) fig. 118, 38.

[1] *Ibid.* fig. 109, *17*

[3] S. R. Rao *op cit* 1963, fig. 43, 101 and 102.

[4] *Indian Archaeology* 1957-58 *A Review*. pl. XXIVB

and perforated neck which could be closed with lids and secured by lashings were useful. The fourth type of lids is rather crude and hand-made. It has a thick flat base and a long knob in the centre (fig. 71, *208*) and occurs in phases III, IV and V. The first three types are found in the Red and buff-slipped wares and the fourth type in the coarse grey ware. A few occur in the coarse red ware also.

L. Ring Stand

Two types of ring-stands used for keeping in position the round-bottomed vessels are noticed in the Red and Buff Wares at Lothal. The type which is identical with the type found in the Indus valley is squattish and sturdy with a concave profile and beaded or beaked rim (fig. 53, *76* and *76a*). It is popular in phases III and IV of Period A and continues to occur in Period B also. Generally, the stands from the Indus valley are painted while those from Lothal and Rangpur are plain. The second, a rare type, is a low stand with convex sides. It is truncated both at the top and bottom and occurs in the Red and Buff Wares in Period A (fig. 64, *156*). As it is not as sturdy as the first type it could not have supported heavy pots. Perhaps it was used for supporting light vessels such as dishes, basins etc.

3. Painting

A. General

Painting was the most popular method of decorating the ceramic wares of the Harappa culture, and provides a clue to its exuberance or decline. It must however be noted that the bulk of Harappan pottery is plain. Among the painted vessels not many carry a pictoral or geometric pattern drawn with a view to produce a pleasing effect. The best of the painted wares can be seen at the height of the prosperity of Lothal in phases II and III. At this stage three styles of painting influencing one another can be distinguished. In the beginning the indigenous style noticeable on the Micaceous Red Ware and the black-and-red ware was distinct from the Indus style. Later on, some of the elements of the indigenous style were incorporated in the Indus Style. Simultaneously a new style designated here the 'Provincial style' was being evolved. In due course the indigenous style was eclipsed but not completely wiped out by the Indus and Provincial styles. The overall degeneration of the Harappa civilization can be better understood with reference to the ceramic industries of phases IV and V when the demand for carefully-slipped and tastefully-painted vessels declined greatly. In Phase V (Period B) some simple designs such as loops, horizontal bands, groups of wavy and oblique lines, dots and hatched diamonds were preferred to elaborate plant and animal motifs and intricate semi-naturalistic and geometric designs. The main features of the three styles of painting prevailing in Period A which shade off into a sub-Indus style in Period 'B' are detailed below.

(i) Indigenous style

This style of painting is mainly confined to the Micaceous Red Ware, the designs being very elementary e.g., wavy lines, loops, dot and occasionally, vegetable motifs. Before painting the vessels the surface was treated with a red ochre slip and wet-smoothed. A fine brush was used for painting. Besides wavy lines and loops, juxtaposed triangles, hatched

[1] *Indian Archaeology* 1961-62 *A Review,* fig. 14, 48.

rectangles and diamonds were also drawn in rows and enclosed between horizontal bands in groups of two or four (fig. 77) on an otherwise plain surface. Painting was always confined to the upper half of the vessel surface. Bowls and jars of the Micaceous Red Ware painted with vegetable motifs such as the wheat plant and blades of grass (fig. 75, *A 48 to A 53*) are considerable in number but no attempt was made to combine naturalistic and geometric designs. Flowing wavy lines are drawn on the Red Ware in the Indus style and on the Micaceous Red Ware in the indigenous style. In the former case they are combined with semi-naturalistic motifs (fig. 75, *A 29* and *A 30*). The plant motifs such as the ear of corn and wheat plant noticed on the Micaceous Red Ware and coarse red ware are distinct from other plant motifs such as the pipal and acacia, the plantain and palm tree drawn by the Harappan potters in a well-defined pattern combining them with other motifs (fig. 42, *9a*, fig. 74, *A 12* to *A 20*). One of them namely wheat plant (?) (fig. 75 A52) resembles a similar motif from pre-Harappan levels of Kalibangan.[1]

In a more elementary form wavy lines, dots and strokes are painted in white on the interior of the Micaceous Red Ware at Lothal and on the black-and-red ware[1] at Rangpur. A few black-and-red ware sherds from Lothal are also painted in white on the interior with dots and wavy lines in groups. The original inhabitants of Lothal who formed a distinct cultural group used the Micaceous Red Ware and black-and-red ware as *de lux* wares and the coarse red ware and the coarse grey ware for cooking and other purposes.

(iii) Indus style

It has often been remarked that the painted ware of Lothal represents a late-or sub-Indus phase but not its mature phase. The co-mingling of the Harappan and indigenous wares of Saurashtra even in the lower levels at Lothal and the survival of the mature Harappan pottery in the later period when new forms were evolved leave an impression of lack of maturity. But a careful analysis of pot-forms and decoration shows that the bulk of the pottery from Lothal A is identical with the mature Harappan pottery of the Indus Valley. The same overall treatment and the same schematisation and division of pot surface into horizontal registers and vertical panels for painting, the same over-crowding and monotonous repetition of designs, and the same combination of naturalistic and semi-naturalistic motifs with geometric designs noticeable on the Indus valley pottery are repeated on the Harappan wares of Lothal A (pl. CLXVI A). Faunal pictorials such as the *acacia*, pipal leaf, palm fish-scale peacock, and other birds appears on several vessels (fig.s 74 & 75). Among typically Harappan geometric designs mention may be made of chequer pattern, continuous loops and wavy lines (fig. 75 *A29-A30*). Birds and plants are often separated by chequer pattern, alternately-hatched squares and triangles and semi-naturalistic motifs (fig. 41, *9*). The human forms and kidney-shaped designs do not however find a place on the painted pottery of Lothal. From the aforesaid details it should be sufficiently clear that the true Harappan wares painted in the characteristic Indus style were in use at Lothal during the hey-day of the town.

(iii) Provincial style

The most important contribution made by Lothal to the ceramic art of the Harappa civilization is a new style of painting evolved indigeneously. It is noted for realism, vigour and fine brush work. Naturalistic motifs, especially plants and animals, were chosen for the theme ignoring the conventionalised floral designs, geometric patterns and semi-natura-

[1] S. R. Rao *op. cit.* 1963, fig. 44 and pl. XXV A.

listic motifs. Another striking feature of this style is that the animals such as deer, stag etc., were depicted in their natural evironment and the over-crowding of designs was carefully avoided. On the other hand, the central figure in the painting was emphasized by subordinating other elements to it. Sometimes the background was plain, but very often the tree was chosen for the landscape. The introduction of narratives is another important contribution made by the Lothal potters to the ceramic art of India. What distinguishes the provincial style from the Imperial style is the highly realistic way in which animals are depicted with full details. Some examples of the Provincial style are noted below:

A sherd from a 'S'-shaped vessel is painted in deep black over deep-red with a stag standing below a tree (fig. 74, *A 1*). The graceful curves of the neck and head and the branching off horns of the animal are in perfect harmony with the drooping branches of the tree.

For vigour and delicacy of lines there cannot be a better example than the miniature 'S'-shaped vase painted in chocolate over buff with a deer looking over its shoulder amazingly at a bird (fig. 76, *A 55*, pl. CLXXI B). Within a narrow space of 2 ins. × 6 ins. the deer and bird flanked by trees are drawn in a life-like manner. The fine brush-work and details of the animals and plants have been produced by a master-artist who has selected for his theme the story of the 'thirsty deer and crow'.

Birds commonly seen in shoals and swamps around Lothal form the popular theme of the Provincial style. Pairs of starks (fig. 74, *A 4*) and cranes (fig. 74, *A 10*, pl. CLXXI C) and other fish-eating birds are frequently painted on the jars. Two birds with hatched body and partly-spread wings and holding fish in the beak are painted on a small jar of Red Ware with a bulbous body (fig. 74, *A 9;* pl. CLXXI B).

Next to birds and caprids snakes occupied an important place in painting earthen wares in the Provincial style. In one case a snake is shown entering the ant-hill and the other is emerging from it (fig. 74, *A 6*, pl. CLXXII A, *4*), while on the third sherd two snakes are depicted standing erect below a tree as if they are about to strike (fig. 74, *A7* pl. CLXXII A *5*). In all these cases the animals are painted in their natural environment in a realistic way. There is no attempt at stylisation or any conventionalism.

The intimate knowledge of the sea which the Lothal people had can be made out from a large whale-like sea animal painted on a sherd (fig. 74, *A 2*, pl. CLXXI A). Water is indicated by wavy lines.

The best example of a combination of the Indus and Provincial styles is the large 'S'-shaped vessel (pl. CLXV, C-D) described earlier.

With several examples of the Provincial style of painting one is inclined to search for its source of inspiration else where than in the Indus valley. Although rows of birds are painted in Giyan IV and Susa I, fish-pecking birds in Gaza IV and Ugarit IIIB, and the gazelle looking over the shoulder in Susa II, it must be admitted that the Lothal potter did not blindly copy them. In combining skilfully the animal and plant motifs he has exhibited originality and imagination which are not to be found in the Indus valley or the Euphratis-Tigris basin. The preference for landscape, the realism of the animal and plant-life, the introduction of narratives and the avoidance of over-crowding motifs are the distinctive features of the new style. It would therefore be utterly wrong to say that the Harappa civilization had come to a dead end by the time it reached Kathiawar. On the other hand, it was highly flexible and ready to receive new ideas from outside and make its own contributions to enrich the civilization in every walk of life. However, as a result of the destruction of the main centres of art and industry, the Harappa civilization degenerated and merged into a successor culture noted for evolved ceramic forms and less ambitions decorative motifs. Generally speaking, vessels painted in the true Indus style were extremely rare in Period B. Although some Indus motifs such as the palm (fig. 88,

B9) plantain tree (fig. 88, *B6;* pl. CLXXVII D 2), conventional leaf (fig. 88, *B12,;* pl. CLXXXII A) and the rosette (fig. 94, *B130* to *B 132;* pl. CLXXXIIA) appear occasionally on the Red and Buff Wares, a simpler style noted for elementary designs came to prominence. Groups of flowing vertical wavy lines (fig. 91, *B64* to *B75;* pl. CLXXX), oblique lines (fig. 90, *B47* to *B53;* pl. CLXXXII), loops with fronds (fig. 93, *B105* to *B110;* CLXXXI B) and spirals interlacing loops (fig. 92, *B100* to *B104;* pl. CLXXXI A) are among the main motifs. Peacock and other birds were gradually stylised (fig. 88, *B1* and *B3*). A bird perching on a tree and holding a fish in its beak (fig. 88, *B5;* pl. CLXXVII D) is a good example of stylization Conventionalised floral designs such as those produced by adding pellets at the ends of intersecting lines (fig. 94, *B128* and *B129*; pl. CLXXXII A) were introduced for the first time. Another remarkable decorative feature of Period B is the arrangement of hatched diamonds and squares as well as circles with dots into vertical and horizontal rows (fig. 89, *B41, B42* and fig. 93, *B121*, fig. 94, *B136*). There are also instances of skilfully combining the Indus and indigenous motifs (fig. 94, *142*) in Period B; the survival in a simplified form of the ceramic art of Period A is a noteworthy feature of Period B. Some of the more significant Harappan motifs are discussed below.

(iv) Motifs

Human Figures—Human figures are extremely rare on the painted pottery of the Indus Valley although several of them are found on seals. There is but one sherd from Lothal on which a couple of dancing figures holding hand-in-hand are vaguely suggested in a highly stylised form on a Buff Ware sherd from Period A (fig. 74, *A3*, pl. CLXXII A). It is also interesting to find human figures on a vessel from Adkot wherein a man is seen leading a horse.[1] The occurrence of several sherds painted with dancing figures at Navda Toli resembling those from Cemetery H and Hissar IIIc, is considered by the excavators as one of the indications of contact with Iran in the post-Harappan period.

Animals.—The tiger, elephant, bull, unicorn and rhinoceros normally engraved on seals are not to be seen on the pottery. On the other hand, the stag and deer which do not find a place on the seals are beautifully drawn on the earthenwares from Lothal, but the ibex and goat noticed on Indus pottery are absent at Lothal. The deer drawn on the Lothal jar is more realistic than the one on Indus pottery. In the post-Harappan period this animal occurs in a highly stylized form in Rangpur IIc and III, Nagda I, Ahar Ib and Navdatoli IIIb.

Fishes of various types are drawn carefully on the pottery from the Indus valley and Kathiawar. Comparable ones can be seen in Nal pottery[2] also. From the size of the copper fish-hooks (pl. CCXLI B) and fish-bones found at Lothal it becomes evident that sea-fishing was an important occupation. The large sea animal painted on a sherd (fig. 74, *A2*) may represent a whale. It may be mentioned here that recently a blue whale came up the Mahi river at high tide and died near Dabka and its skeleton is preserved in the Museum at Baroda. It is likely that whales were moving in the Arabian sea in protohistoric times also.

Snakes have not been painted on the Indus Valley pottery, but they are depicted in pairs on the vessels from Lothal. In one case two snakes are shown springing from

[1]*Indian Archaeology* 1957–58, *A Review*, Fig. 12, *1*.

[2]S. Piggot *Ancient India*, no. 1, Fig. 3.

the ground (fig. 74, *A7*). In another case a snake is entering the anthill and another emerging from it (fig. 74, *A6*). On a third sherd they are indicated by mere wavy lines (fig. 74, *A8*). Perhaps serpent worship was in vogue at Lothal.

Birds:—Among naturalistic motifs birds are very frequently painted at Lothal. Some of them are shown perching on trees and others fluttering. (pl. CLXV C-D). Yet some others are shown walking majestically The potter has faithfully reproduced the cranes and starks which he used to see in the fields daily. Fish-eating birds formed the theme for painting on a S-shaped vessel and a small jar (fig. 74, *A9*) from Period A. The peacock occurs in the Harappan style on large jars and in a slightly different form with hatched body and spread plumes on a sherd from Period A (fig. 74, *A5*). It is greatly stylized in Period B, the transition stage being represented by a peacock on a pedestal-bowl from Rangpur IIB[1]. The Lothal figure has thick plumes and a narrow body. The best example of stylization is a bird holding fish in its beak appearing on a pot-sherd from Lothal B. Another example (fig. 88, *B2*) is provided by a sherd from Period B painted with two birds, the bigger one chasing the smaller.

An analogy can be drawn between the birds painted on the vessels from Lothal and those noticed on the vessels from Gaza, Ras Shamra and Susa. Birds pecking fish are noticed at Ras Shamra in Ugarit III[2] and Gaza IV[3]. In Giyan III[4] they are seen sitting on hill tops. Rows of birds are in evidence on the pottery from Susa I and II[5]. The Lothal artists were great admirers of nature. They loved painting a variety of trees and plants. The plam-tree, *pipal* leaf, acacia and plants with bipinnate leaves are among the common motifs painted on the Harappa Wares of Lothal from Period A. Wheat plant and chaff which occur on the Micaceous Red Ware are a special contribution of Lothal to Harappan vegetal motifs. The pipal leaf motif painted in full detail is noticed on the Associated Wares also. The pipal-leaf motif is known from Samarra, Giyan, Tehubme-Ali, Tal-Baker, Tepe-Gawra and Mundigak. Rosettes, derivative leaf patterns and certain floral designs produced by hatching the interspace between intersecting circle and semi-circles or independently are innovations of the Harappans in the Indus Valley which the Lothal potter too reproduced. In period B, however, simple floral patterns produced by enclosing lines with arcs or adding pellets at the end of intersecting lines were preferred to the more sophisticated designs of mature Harappan period.

Boats.—One of the most interesting designs painted in black over red is that of a boat with multiple oars. There are two such sherds (fig. 76, *A56* and *A57*). In one the waves are indicated by wavy lines below the boat as if it is floating over the surf.

Miscellaneous Motifs.—The sun motif is depicted by a circle and rays singly or in rows in Periods A and B. The river is shown by flowing horizontal wavy lines in Period A. It became a more popular motif in Period B.

Geometric Designs.—The skill of the Harappan potter lies in the blending of naturalistic, geometric and linear designs in a single panel or successive panels. Diamonds, triangles, lozenges, chequers, scales and ladders were introduced between panels of naturalistic and semi-naturalistic motifs. Hatched or filled triangles drawn in a series or in groups, squares divided into triangles and hatched alternately were drawn for the purpose of space-

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[1]S. R. Rao *op. cit.* 1963, fig. 29, *28*.

[2]Schaeffer *op. cit.* 1948, fig. 307.

[3]*Ibid*, fig. 129.

[4]G. Contenau and R. Ghirshman, *Fouilles du Tepe Giyan, Tome* III, (Paris 1935), Pl. XIII, 8.

[5]D. Morgan, *Delegation en Perse Memoire, Tome I* (Paris 1900) pl. XX.

filling. Sometimes cross-hatched squares in isolated blocks or as part of the chess-board pattern served the same purpose. The triangles in diagonally divided squares were also hatched. Diamonds occur singly or in groups of two or four on many vessels, especially on the bowls in Period B at Lothal and Rangpur IIc and III. Hatched diamonds and triangles and cross hatched panels seem to have been borrowed by the chalcolithic folk of Central India and the Deccan from the Harappans.

LINEAR DESIGNS.—These vary from simple lines to sophisticated patterns sometimes covering a large part of the painted surface. The most elementary designs are the wavy and oblique lines and strokes and dots in groups. They occur on the black-and-red ware. Horizontal bands and zig-zag lines are painted with a fine brush on the rim or shoulder of the bowls and jars in the Micaceous Red Ware. Hatched circles occur on the Harappan wares and less frequently on the associated wares. Strokes and concentric circles occur on the interior of the dishes (fig. 48, *42f*) and hatched semi-circles and circlets on the jars. Horizontal bands are common in Period A on large storage jars, dishes-on-stand and small vessels meant for cosmetics. These bands are not uniform in Period B. The straight lines drawn horizontally or in cross-hatching are not infrequent in Lothal A, but they are more common, especially oblique lines, in Lothal B. Using straight lines as fillers or dividers is common to Indus Valley and Kathiawar. The vertical ladder and associated designs of Lothal B are the precursors of comparable Navdatoli ladders. Vertical chevrons and vertical columns of horizontal strokes, however, remind us of Giyan designs. The wavy and zig-zag lines were less popular in Lothal A and Indus sites. Whenever employed as in painting, the large ritualistic vessel or S-shaped jar they served as fillers and dividers. It is only in Lothal B that they were treated as primary motifs. Harappan motifs such as interesecting circles, chequers hatched leaf and stretched hide motifs do occur with considerable frequency in Lothal A. It would be wrong to presume that these and other primary motifs of mature Harappan sites of the Indus Valley were not in vogue in Kathiawar. Even the pipal leaf, peacock and a variety of plant motifs are well represented in Lothal A and to a limited extent in Lothal B.

The frequent use of linear patterns on the vessels from Period B cannot be considered as indicating the arrival of a new group of people culturally different from the Harappans. Mention has already been made of the occurrence of oblique, wavy and vertical lines in groups on the Harappa wares in the Indus Valley as well as Kathiawar in combination with naturalistic and semi-naturalistic motives (fig. 42, *9a*). The process of evolution of the Harappan ceramic wares was a continuous one from Phase IV to Phase V without any break as clearly borne out by the Carbon-14 dates for the late levels of Period A and the early levels of Period B. The decadence in the prosperity of the town greatly restricted the demand for vessels elaborately painted in the Indus style. The potter met the demand of the less fortunate successors by drawing a few simple oblique or wavy lines and loops on a limited surface, which itself was hurriedly covered with a thin slip. No doubt some of these simple designs painted in Lothal B are noticed in the second millennium B.C. levels of Sialk, Giyan, Hissar or any other west Asian site, but the very fact that they were known in Lothal A should not be ignored. They occur sporadically in an inconspicuous way on the Harappan vases. Another series of Late Harappan motifs consists of short oblique or vertical strokes, wavy lines (pl. CLXXX), loops with or without fronds (pl. CLXXXI A-B) and flowing vertical wavy lines. They occur not only in Lothal B but also in Rangpur IIB and IIC, Prabhas IIA, and Rojdi IB and IIA and survive in Theur in 1200 B.C. From the foregoing details itbecomes evident that the potter made an attempt to cater to the needs of the less sophisti cated folk by executing simple designs which required less effort and time than the pots painted in the Indus and Provincial styles of the earlier period needed.

Finally, among the Indus designs conspicuously absent on the Lothal vessels mention may be made of the ibex, the human forms, the kidney-shaped design and the hollow cross. The open net design is produced in a slightly different way at Lothal by hatching the interspace between arcs (fig. 78).

B. Pigments

A large number of painted vessels in Red and Buff wares were given an ochre wash and fired before painting in red or chocolate colour. This is evident from the fact that there is little cohesion between the pigment and the surface and hardly any evidence of the sintering of the pigment layer. Furthermore, the striations are not obliterated by the wash. In some cases however the striations are hidden by a thick solution of black or red ochre colour used almost like a slip. Large jars with concavo-convex profile and 'S'-shaped vessels painted in the Indus style are ochre-slipped. The pigments used for the slip and for drawing various designs show the presence of manganese and iron. Hence the colours may have been prepared from a manganiferous ore.

The inner and outer surfaces of the bowls in the Micaceous Red Ware and dishes in the Red Ware are well finished and painted. A fine slip of reddish colour is applied on the inner surface and a yellowish buff slip on the exterior using red and yellow ochres respectively. In a few instances the Buff Wares vessels have a reddish slip on the interior and a buffish one on the exterior. The deep-red ochre wash given on the exterior of some vessels has largely flaked off exposing the buff surface. At times a slip of pale yellow or buff colour is applied on the outer surface and painting is executed in dark ochre red; the interior is also treated with a thin slip. The chocolate colour of the pigments is due to the presence of iron and manganese.

C. Reserved Slip

Lothal has yielded a few sherds of light grey-cream and red wares treated with a pink and grey or white and grey or black and white slips one above the other. In each case the upper slip is removed partially with a comb-like instrument exposing the lower slip partially. Mackay thinks that these sherds must have been covered with a white glaze over the slip and that a portion of the glaze was partially removed,[1] but the presence of glaze is not proved chemically (below p. 470). The Reserved Slip Ware at Harappa, Mohenjo-daro and Lothal was imported in the course of foreign trade from an area where it was very popular. It is an important ceramic ware supplementing other evidences in dating Lothal.

D. Bichrome Ware

Except in very few cases the use of two colours was not resorted to by the Lothal potters. Generally a single colour, namely, black or chocolate in the case of the Red and Buff Wares, and white in the case of the black-and-red ware, was used for painting. The bichrome effect was however produced in several cases by applying red and buff slips or washes in two adjoining registers which were painted over in black or chocolate.

Quicklime appears to have been used for painting in white on the interior black surface of the black-and-red ware and very rarely in the case of the coarse red ware vessels. Occasionally, red colour was also used for painting. About half a dozen vessels are

[1]Mackay *op. cit,* (1938), p. 652.

found to have been painted in red. In one instance a floral design is drawn in red with outlines in black.

The skill of the potter consists in mentally arranging the various designs before actually executing them on the vessel surface. Normally, the exterior of the vessel is painted but in the case of the dish and bowl the interior is also decorated. The convex-sided and stud-handled bowls of the Micaceous Red Ware are painted on both the surfaces. The S-shaped vessels and large jars with concavo-convex profile and small globular jars are painted all over the exterior. In the case of other vessels painting is confined to the upper half of the vessel, the lower half being treated at times with a fine slip, different in colour from the slip or wash applied in the upper half. For executing the painting in the Harappan style the vessel surface was divided into horizontal registers which were further subdivided into a number of vertical panels each covered with geometric or naturalistic motifs or with both. The Provincial style introduced by the Lothal folk did not follow any such convention.

4. POTTERY OF PERIOD A.

A. General Observations

Mention has already been made of two cultural periods, namely, A and B, the former representing the mature phase of the Harappa culture and the latter the late or decadent phase. Period A is further subdivided into four structural phases. So far as the study of the ceramic industries of the site is concerned no major change is noticeable in any of the four phases of Period A excepting the poorer treatment of the vessel surface and the gradual discarding of certain ceramic types in the late levels of Phase IV. However, the very fact that goblets, beakers etc., gradually went out of use in phase IV and new forms were evolved in phase V suggests that changes in food habits and social customs which were vaguely visible in the last days of Period A became more pronounced in Period B. It is therefore not correct to say that there was a dead uniformity in the ceramic traditions of the Harappans in Period A from beginning to the end. The indigenous forms such as the bowl and the round bottomed jar were included in the ceramic kit of the Harappans. The Buff Ware became a little more popular at Lothal than at Harappa and Mohenjo-daro. But as mentioned elswhere this buff colour was due to the presence of lime in the clay and cannot be considered as the ceramic ware of an intruding culture. In the light of the provincial character of Lothal the so-called dead uniformity of the ceramic industry of the Harappan sites seems to be an exaggeration.

For quantity and variety of forms and decoration of earthenwares, phases II and III are better known than phase I. With the decline in the prosperity of the town in phase IV finer wares became scarce but the scoured goblet, globular jar with a slightly raised neck and the bowl-on-stand were brought into use for the first time. The dish-on-stand with ball-moulding or with a broad squattish stem became more popular but the goblet, beaker and perforated cylindrical jar gradually declined in number. The indifference shown by the potter in the preparation of the clay and treatment of the surface of the vessels resulted in the poorer fabric at the end of Period A when minor changes are already noticeable in the form of the convex-sided bowl which developed thick straight sides thus marking the first step towards its evolution into a carinated bowl in Period B.

Generally speaking, the Harappan and Associated Wares of superior fabric are of medium thickness and well-fired. They have a smooth surface which is treated with a wash or slip. The coarser wares are neither well-fired nor is their furface smooth. On the other hand the fabric shows the use of grit. The following ceramic wares are encountered in Period A.

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Harappa Wares
1. Red Ware
2. Buff-slipped Ware
3. Buff Ware.
4. Green Ware.
5. Grey Ware

Associated Wares
1. Micaceous Red Ware
2. Black-and-red ware
3. Coarse red ware
4. Coarse grey ware.

Ceramic Wares of foreign origin
1. Reserved Slip Ware.
2. Buff Ware.

B. Harappa Wares

(i) *Red Ware*

Vessels with a reddish core and made of a fine clay are sturdy, well-fired and emit a metallic sound when struck. Except in a few cases where a faint greyish zone is visible, the surface and core are reddish in colour. No coarse degraissant or vegetable matter was used with the body material. Fine sand occurring as a natural impurity in the alluvial clay perhaps helped tempering, or else it was deliberately added. But for a few miniature vessles and large storage jars which are hand-built, all the vessels are wheel-turned, and a majority of them are treated with a red ochre slip or wash and painted after firing. It must, however, be noted that in a few cases painting is executed before firing. The colour scheme normally adopted is black on a red background. Manganiferous red ochre used for the pigment produced a light black or chocolate colour. A purple shade is noticed on very few vessels. All the characteristic Harappan forms such as the goblet, beaker, cylindrical perforated jar, 'S'-shaped jar basin with carinated shoulder and fiat base, large storage jar with expanded rim, lamp with pinched lip, cup with perforated ear, dish with projected rim and the dish-on-stand are found in Red Ware. Among important naturalistic designs painted on the vessels mention may be made of the stag, peacock, crane, snake, fish, pipal tree, palm and acacia. Other patterns include derived leaf-patterns, intersecting circles, chevrons, hatched and plain triangles, lozenges, spirals and loops which are combined with naturalistic and semi-naturalistic motifs. Cord impressions are noticed on the shoulder of large jars.

Fig. 39A

Type 1. Large storage jar of medium fabric[1] with a splayed-out and beaked rim and ledged shoulder. Thin-red slip. From middle level.[2] *Variant 1a,* with a wider mouth, blunt rim and less prominent ledge at the shoulder. From middle level. *Variant 1b,* with a thick rim. From middle level. *Variant 1c,* with a short thick rim. Original buff wash visible wherever dark-red slip has flaked off. From middle level.

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[1]Vessels whose section is. 25. ins. or less in thickness are said to be 'thin', while those between .28 and .5 in. thickness are considered to be 'medium' and vessels more than .5 in. thick in section are deemed to be 'thick'.

[2]Early level—phase I; middle level phases II and III and late level phase IV.

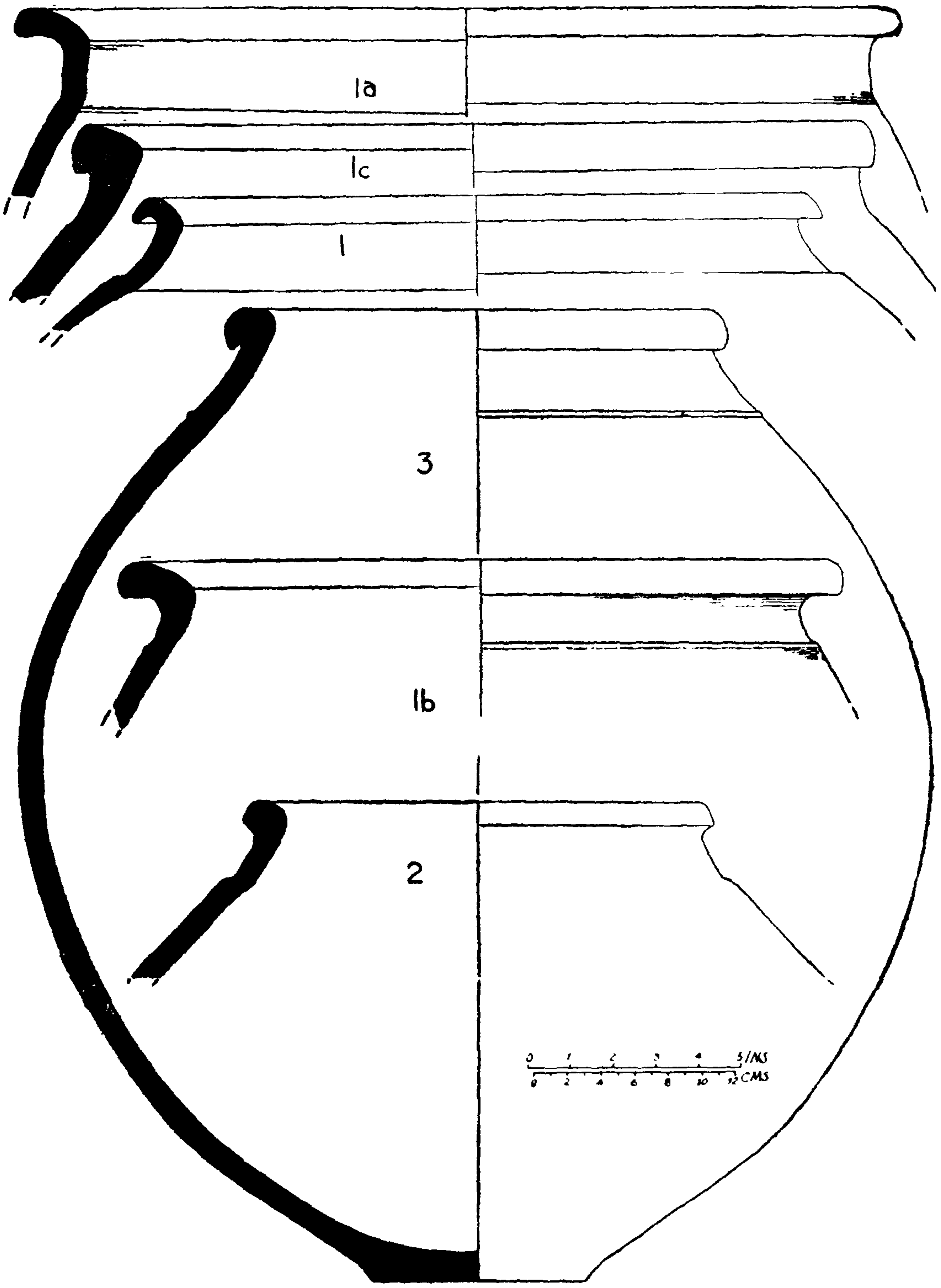

FIG. 39A. *Red Ware, Period A, Types 1-3*

Type 2. Storage-jar of medium fabric with a short obliquely-cut rim, narrow mouth and ledged shoulder. Thin-red slip flaked off at several places. From middle level.

Type 3. Storage jar of medium fabric with a narrow mouth, flat-projected rim and mild rib on the shoulder. Intermittently treated with a red slip over a buff background producing a bichrome effect. Black horizontal bands. From late level, (pl. CLXV A).

Fig. 39 B

Type 4. Storage-jar of medium fabric with a wide mouth, splayed-out rim and convex sides. Painted in black over red on the exterior with two horizontal bands below the rim. From middle level. *Variant 4a,* with a flaring rim and ribbed shoulder. Dark red slip applied partially over a buff wash to produce bichrome effect. From late level. *Variant 4b,* of small size with a beaked rim, convex profile and narrow flat base. Light red slip. From late level. *Variant 4c,* with a flat projected rim. Painted with black loops and horizontal bands. From surface. *Variant 4d,* with a thick projected rim. From middle level. *Variant 4e,* with a clubbed rim. Red slip applied over a buff background producing a buff band. From late level.

Fig. 40

Type 5. Large storage-jar of thick fabric with a wide mouth, flat projected rim, convex profile and narrow flat base. Deep-red slip applied over a buff background and impressed cord design produced on the lower part. From late level, (Pl. CLXV B). *Variant 5a,* with a beaked rim. Painted in black over red on the exterior with horizontal bands. From late level. *Variant 5b,* with a clubbed rim and flat top. From late level.

Type 6. Large storage-jar of medium fabric with a wide mouth and externally-collared rim. From late level.

Type 7. Large storage-jar of medium fabric with a concave pointed base luted to the body. Excessive clay scooped out from the base with the help of a blade. From middle level.

Type 8. Pyriform-jar with a concave base. Red slip applied on the interior and a chocolate slip on the exterior. From surface.

Figs. 41 and 42

Type 9. 'S'-shaped jar of medium fabric with a narrow flat base and flanged rim painted all over the exterior in chocolate over a buffish slip. It is an excellent example of the combination of the Harappan and Provincial styles of painting. The surface is divided into four horizontal registers each separated by one or more horizontal bands. The lowest register is painted with cross hatched leaf-pattern derived from intersecting arcs while the one above it depicts a row of enclosed sun motifs in a cross hatched panel, which is succeeded by a criss-cross pattern. The uppermost register is divided into four vertical panels, two of which are noted for semi-naturalistic forms such as the pipal-trees, the palms and the rosette-like floral units. The third panel depicts diagonally sub-divided squares with alternately hatched triangles while in the fourth one a complete story is narrated through the pictorials. Two birds with partly open wings and holding fishes in their beaks are shown perching on a palm-tree. Legs of two birds flying high up in the sky indicate other birds have flown away after dropping the fishes. Three falling fishes are shown above one of the birds fluttering on the tree. Still more significant is the fox-like animal which is about to run away with the fish dropped on the ground. Obviously the artist has tried to narrate the story of 'the cunning fox and the crow' wherein the fox is trying to snatch away the fish from the birds after flattering them. In the lower half of the adjacent panel a caprid is shown grazing on a palm-like tree. The animals and plants are painted in a free style which is more realistic than the normal Indus style. For the first time the Lothal potter has introduced here a narrative in painting earthen wares, (pl. CLXV C-D) *Variant 9a,* of larger size with a concavo-convex profile painted in black over red in superimposed horizontal registers with derivative leaf-patterns, sun-motives etc. In the uppermost register the palm and pipal trees, wave patterns, peacocks holding leaf in the beak

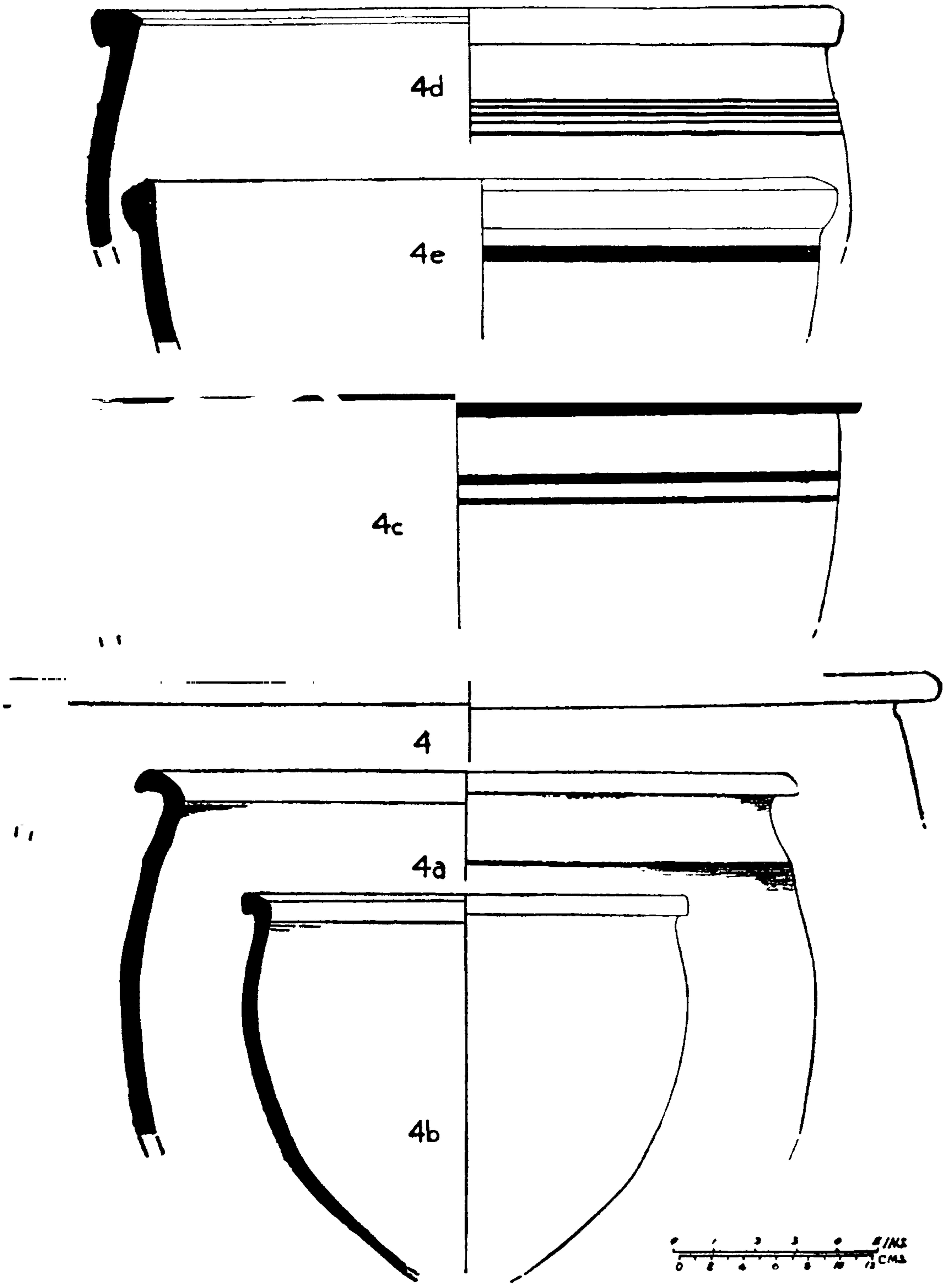

FIG. 39 B. *Red Ware, Period A, Types 4 to 4e*

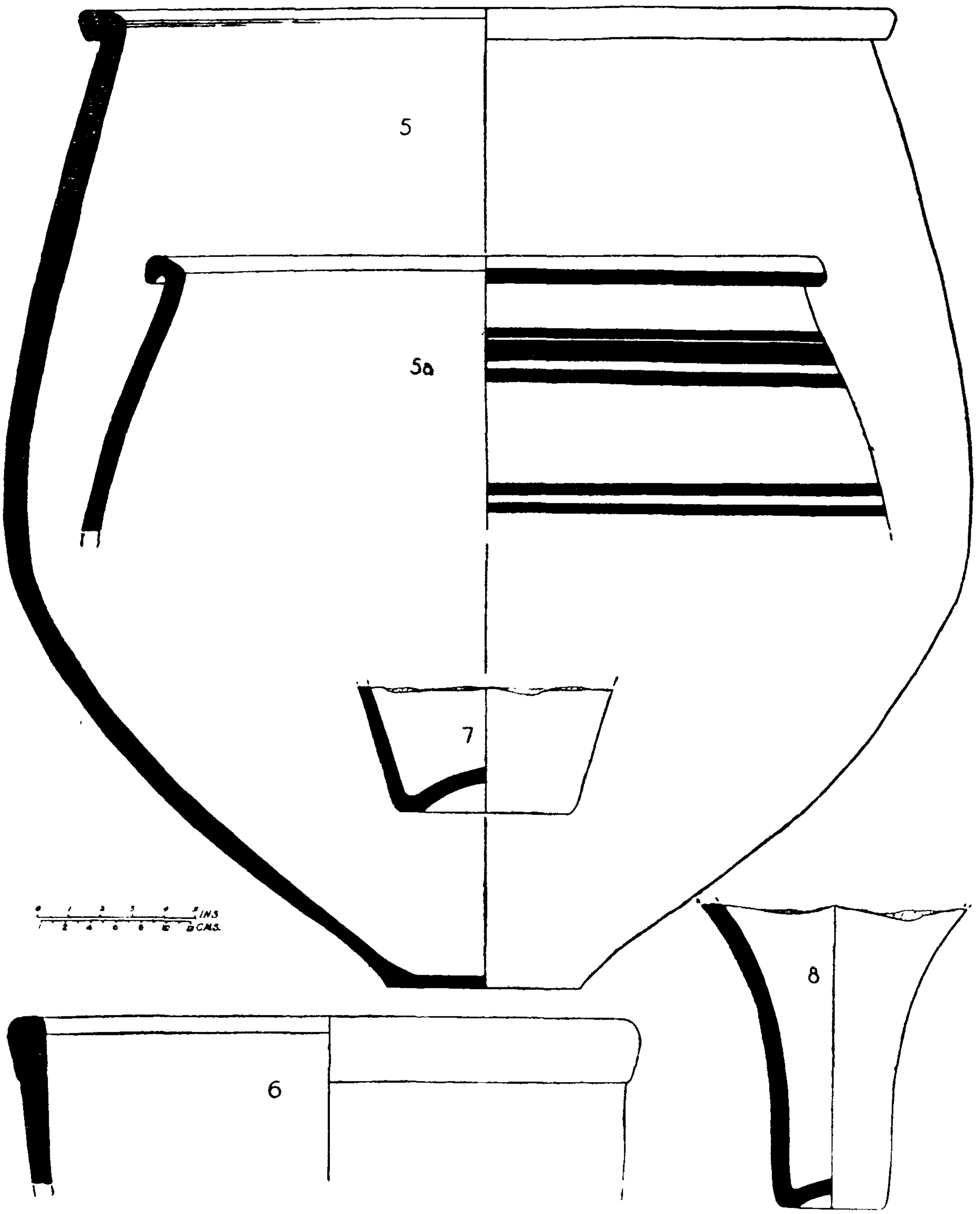

FIG. 40. *Red Ware, Period A, Types 5 to 8*

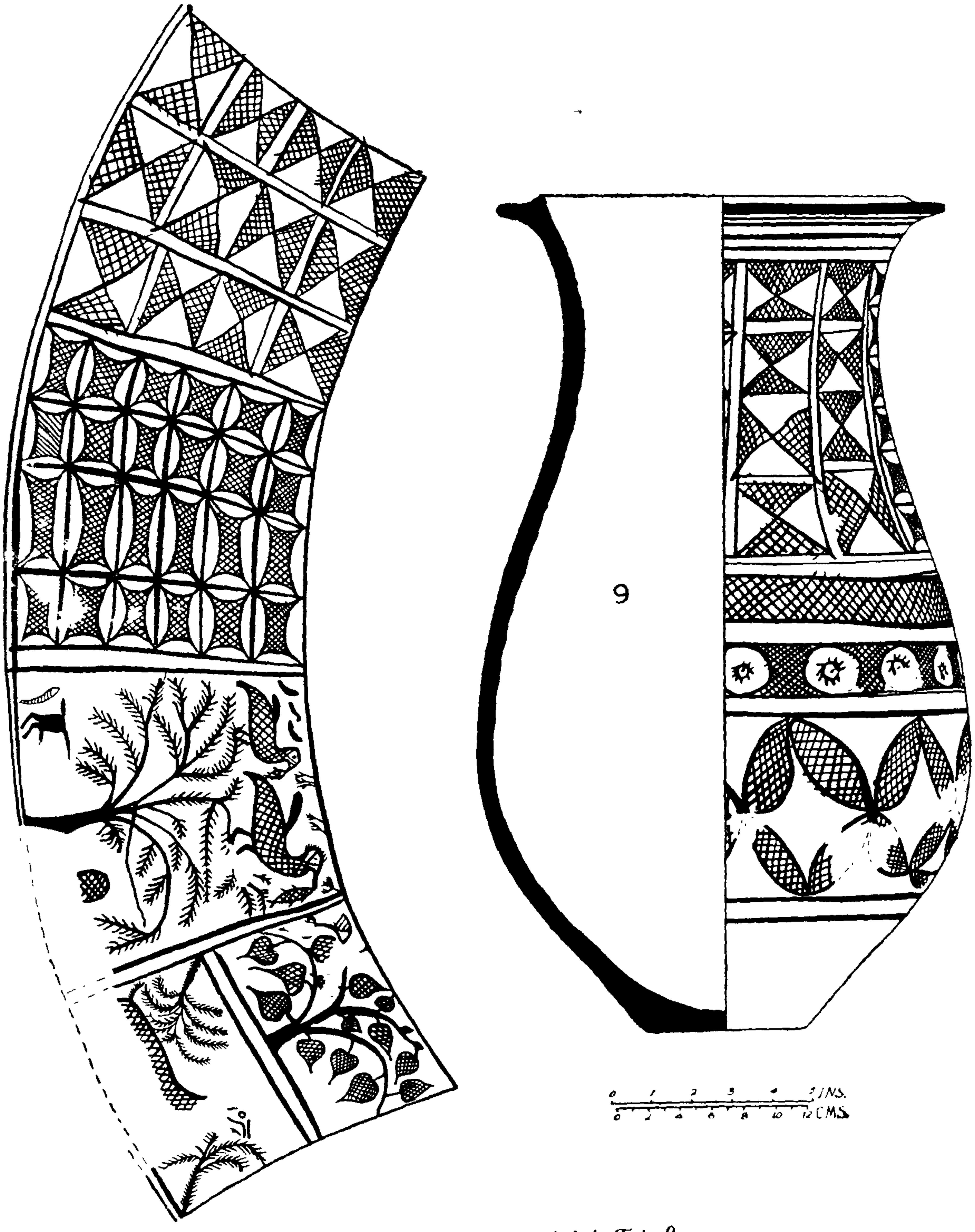

FIG. 41. *Red Ware, Period A, Type 9*

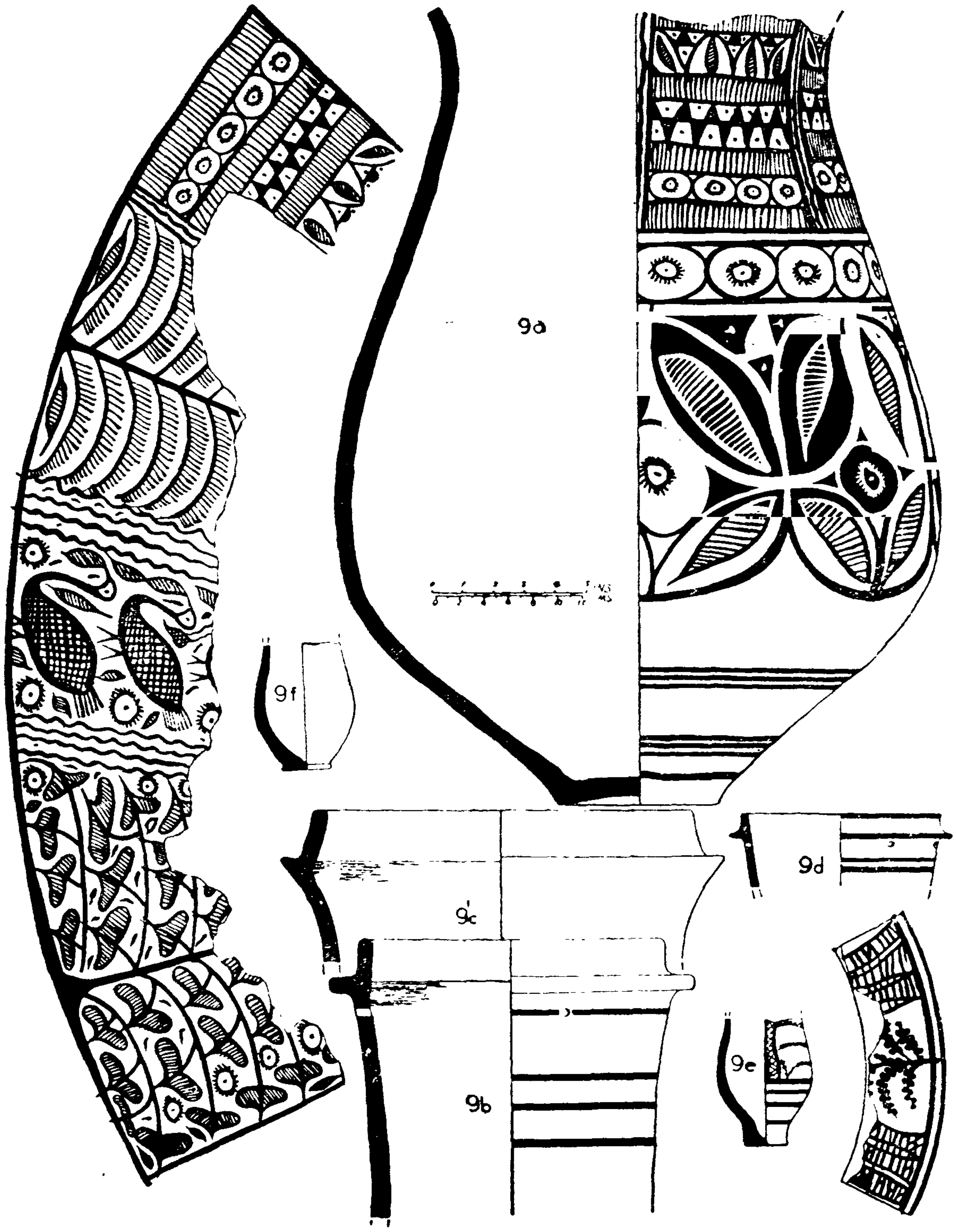

FIG. 42. *Red Ware, Period A, Types 9-9f.*

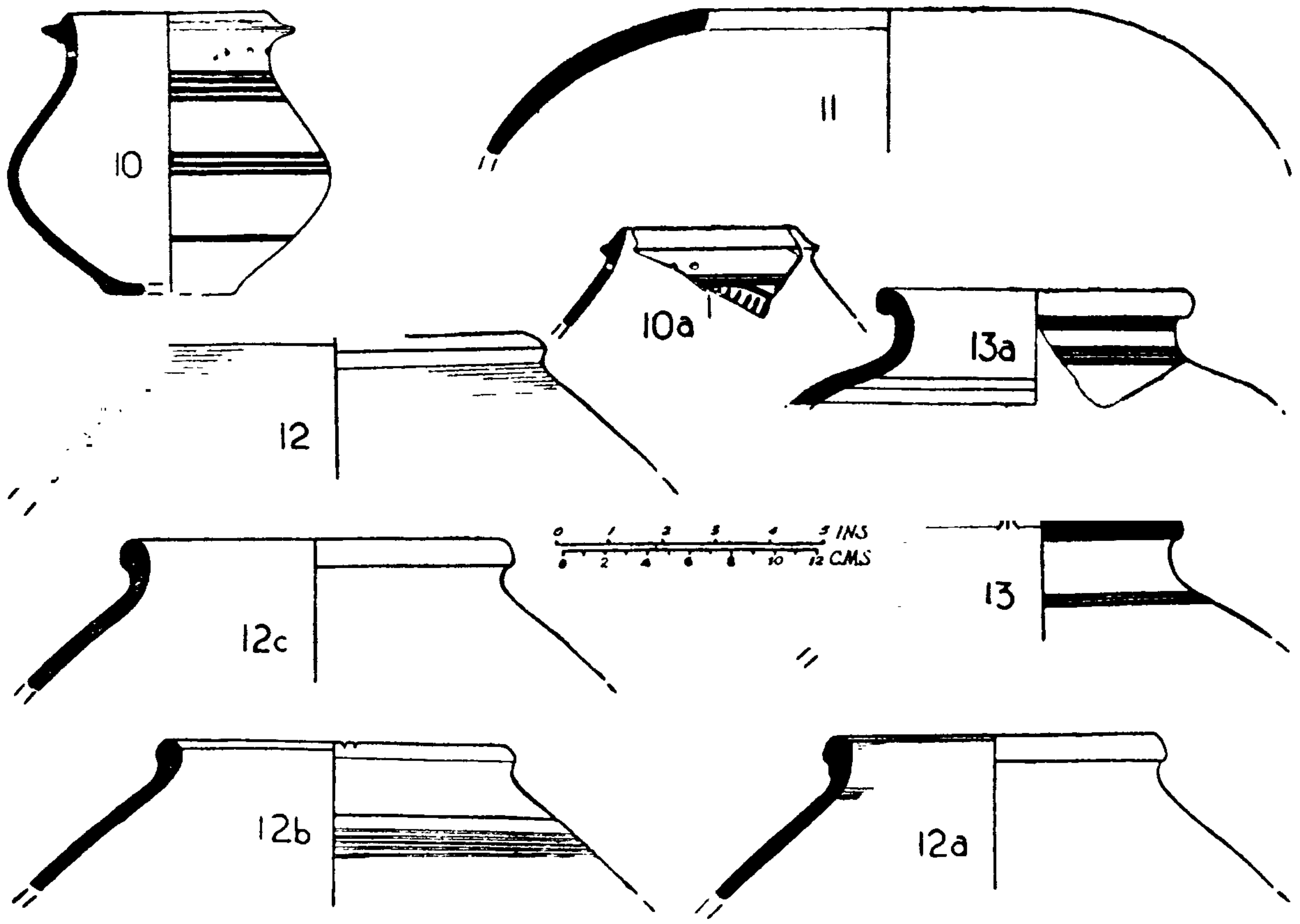

FIG. 43. *Red Ware, Period A, Types 10-13A*

of sun-motifs, filled triangles, hatched leaves etc., are depicted (pl. CLXVI A). This jar painted in the typical Indus style combines naturalistic and semi-naturalistic pattern was found placed near the fire altar in Street 9 and must have therefore been used for a ritualistic purpose. From middle level. *Variant 9b,* 'S'-shaped jar of medium size with a flange at the rim for holding a lid which was secured with lashings. The hole noticed in the wall below the flange was meant to pass the lashings through. From middle level. *Variant 9c,* with a sharp flange for holding the lid but without an perforation. From late level. *Variant 9d,* with a hole below the flange. Painted in chocolate over buff with horizontal bands on the exterior above and below the flanged rim. From middle level. *Variant 9e,* with a concavo-convex profile and footed base. Painted in black over red with tree and open net designs above four successive horizontal bands. From late level.

Fig. 43

Type 10. Squattish jar of thin fabric with a wide mouth, flanged rim, flat base and holes for suspension below the rim. Painted in black over red of the exterior with two horizontal bands. Patches of and red seen on surface owing to differential firing. From middle level. *Variant 10a,* with a short neck. Painted in pink over dull-red with leaf-design and horizontal bands. From middle level.

Type 11. Jar of medium fabric with a featureless rim. From middle level.

Type 12. Jar of medium fabric with a beaded rim and narrow neck. From late level. *Variant 12a,* with a slightly raised neck. Applied red and buff slips. From middle level. *Variant 12b,* with a group of five horizontal grooves at the shoulder and two oblique slashes at the rim. Thin wash. From surface. *Variant 12c,* with a slightly raised neck. Slip flaked off. From late level.

Type 13. Jar of medium fabric with a beaded rim, slightly raised neck and globular body. Graffitti mark at the rim and painted in black over red with horizontal bands. From late level *Variant 13a,* with a raised neck. From surface.

Fig. 44

Type 14. Small jar of medium fabric with a beaded rim, raised neck and globular body. Red slip on the exterior of almost flaked off. From middle level. *Variant 14a,* painted in black over red with horizontal bands all over the profile. From middle level. *Variant 14b,* with a globular body and disk base. From late level. *Variant 14c,* with a short flaring rim and ovoid body. From middle level. *Variant 14d,* with a flaring rim and smooth red surface. Painted in black with a red broad band at the rim and horizontal lines below. From late level.

Type 15. Small jar of thin fabric with a wide flared mouth, globular body and disk base. Painted in black over red with horizontal bands on the exterior. From early level.

Type 16. Jar of medium fabric with a flaring rim and globular body. Red slip applied. From late level. *Variant 16a,* with white slip applied over a dull-red one on the exterior, upper slip partially removed with a comblike instrument in the 'reserveslip ware' technique, to produce horizontal wavy lines. From late level.

Type 17 Jar of medium fabric with a flaring mouth, obliquely-cut rim and globular body From late level *Variant 17a,* with a projecting rim From early level *Variant 17b,* with a raised neck Painted in black over red with a horizontal band at the rim From late level

Type 18 Jar of medium fabric with an externally projected rim, grooved neck and bulbous body. Painted in black over red with horizontal bands at the shoulder. From late level.

Type 19. Jar of medium fabric with a projected rim and globular body slip flaked-off. Painted in black over red with horizontal bands and a fragmentary design. From late level.

Type 20. Jar of medium fabric with a flat projected rim and ledged shoulder. Painted in black over red with horizontal bands on the shoulder and loops on the rim. From late level.

Tyoe 21. Jar of medium fabric with a splayed-out rim and globular body. Chocolate slip applied. From late level. *Variant 21a,* with a ledge at the rim to receive the lid. From late level.

Type 22. Jar of medium fabric with a flaring mouth beaked rim and raised neck. Painted in black over dull-red with horizontal bands at the rim. *Variant 22a,* with a beaded rim. From late level. *Variant 22b,* with a beaked rim and high neck. From late level.

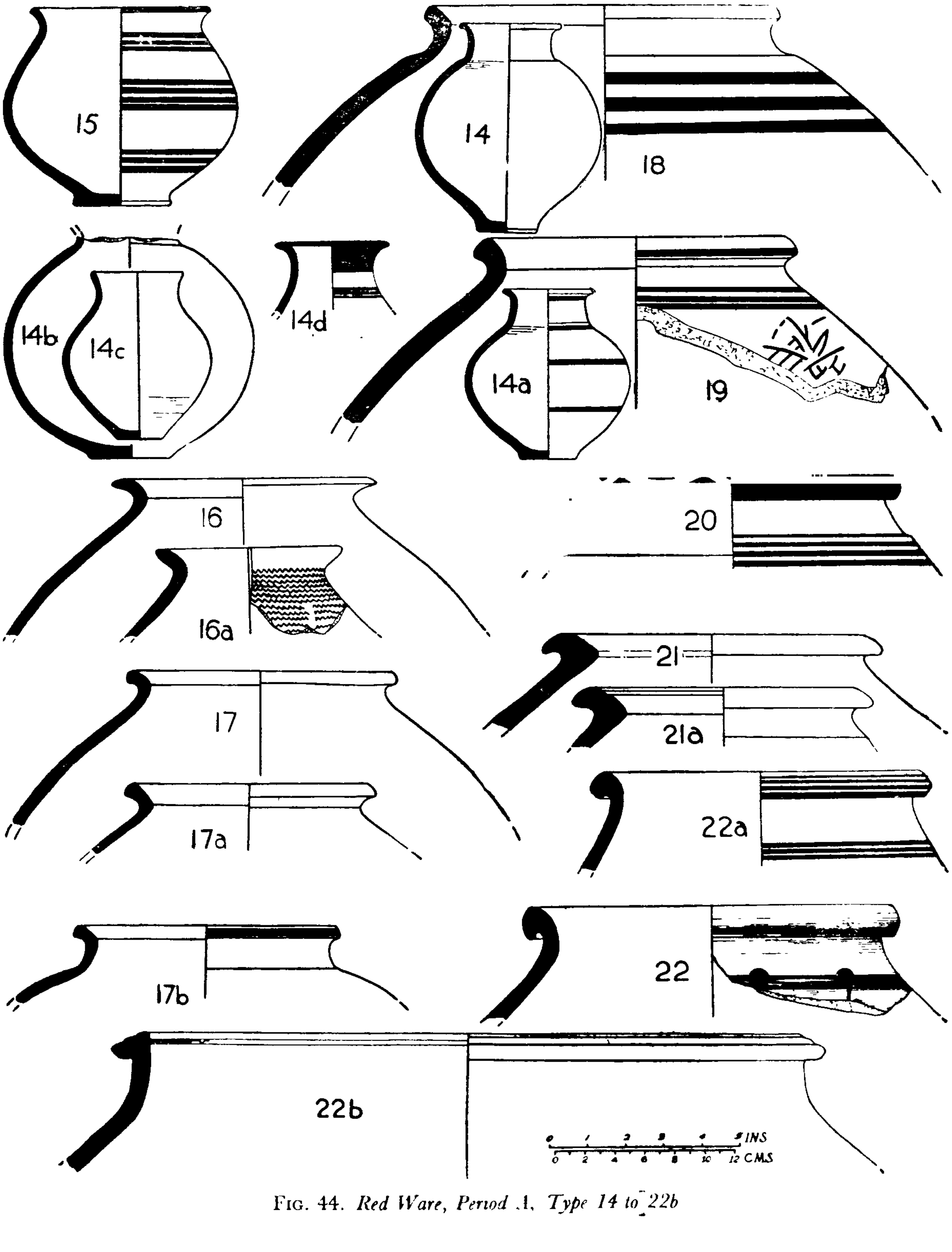

FIG. 44. *Red Ware, Period A, Type 14 to 22b*

Fig. 45

Type 23. Jar of medium fabric with a flaring mouth, everted rim and ribbed shoulder. From late level. *Variant 23a,* with a prominent ridge on the shoulder. Sturdy fabric. From late level. *Variant 23b,* painted in black over red with horizontal bands on the rim and shoulder. Slip confined to the upper part. From late level. *Variant 23c,* with a mud-coating on the bottom. From late level. *Variant 23d,* with a smooth surface slipped red in the upper part and buff in the lower. From late level.

Type 24. Jar of medium fabric with a flat projected rim, perforated sides and holes for suspension. From late level.

Type 25. Jar of medium fabric with pedestal base perforated in the bottom. From late level.

Type 26. Cylindrical perforated jar of medium fabric with an everted rim. Dull-red slip on the exterior. From late level. *Variant 26a,* with a flat projected rim. From late level. *Variant 26b,* with a flaring rim and cordoned shoulder. Surface affected by water. From late level. *Variant 26c,* with a flat disk-base and a large hole in the bottom. From late level. *Variant 26d,* with a rounded bottom. From surface.

Type 27. Perforated vase of medium fabric with a footed base. From middle level. *Variant 27a,* with a hole in the bottom. From late level. *Variant 27b,* with a hollow pedestal base. From late level.

Fig. 46

Type 28. Vase of thin fabric with flaring rim. ovoid body and flat footed-base. Chocolate slip on the exterior. From middle level (Pl. CLXVII A, *1.*) *Variant 28a,* with a wide body and narrow base. Shining chocolate slip on the exterior. From late level. *Variant 28b,* with a ring-footed base and grooved interior. From late level.

Type 29. Vase of medium fabric with a footed base and grooved sides. From middle level. (Pl. CLXVII A, *2.*)

Type 30. Vase of thin fabric, almost similar to goblet, with a high neck, narrow bottom and flat base. From late level, (Pl. CLXVII A, *3.*) *Variant 30a,* with flaring rim and pointed base. From late level. Pl. CLXVII B *1. Variant 30b,* of medium fabric with pointed base and pared all over. Pl. CLXVII B, *2. Variant 30c,* and *30d,* with minor differences such as rounded, pointed base. First one from late level and the other late level. Pl. CLXVII B, *3* and *4. Variant 30e,* with a rounded bottom. From late level.

Type 31. Goblet of thin fabric with a globular body and flat-bottom, broken rim and smooth top. Painted in black over red with horizontal bands on the exterior. From late level.

Type 32. Goblet of thin fabric with a flaring mouth, globular body and pointed bottom applied chocolate slip on the exterior and three strokes visible at the shoulder. From late level. *Variant 32a,* with a bulbous body. From late level. Pl. CLXVII B, *5, Variant 32b,* squattish. From late level.

Type 33. Goblet of thin fabric with a pointed base and stroked shoulder. From late level of Phase IV.

Type 34. Goblet with a pointed base, thin fabric From late level of Phase IV.

Type 35. Beaker of thin fabric with a flaring mouth, concave profile and flat base. From early level. *Variant 35a,* squattish with a thick base and concavo-convex sides. From middle level. Pl. CLXVI B, *1. Variant 35b,* with carination near the base. From middle level. *Variant 35c,* with deep concave sides and thick base. From early level. *Variant 35d,* of small size and concavo-convex sides. From middle level. Pl. CLXVI B, *2.*

Type 36. Beaker of medium fabric with a flat base and almost-straight sides. Grooved internally. From late level.

Fig. 47

Type 37. Dish-on-stand of medium fabric with a ball-moulding at the top and a rib below. Red slip applied on the exterior. From middle level. *Variant 37a* miniature dish-on-stand. From middle level. *Variant 37b* with a broad beaded rim at the base and grooved interior. From surface. *Variant 37c,* stem of medium size. Painted in black over red with horizontal bands. Exterior pared. From late level. *Variant 37d,* stem of a bowl on stand. From middle level.

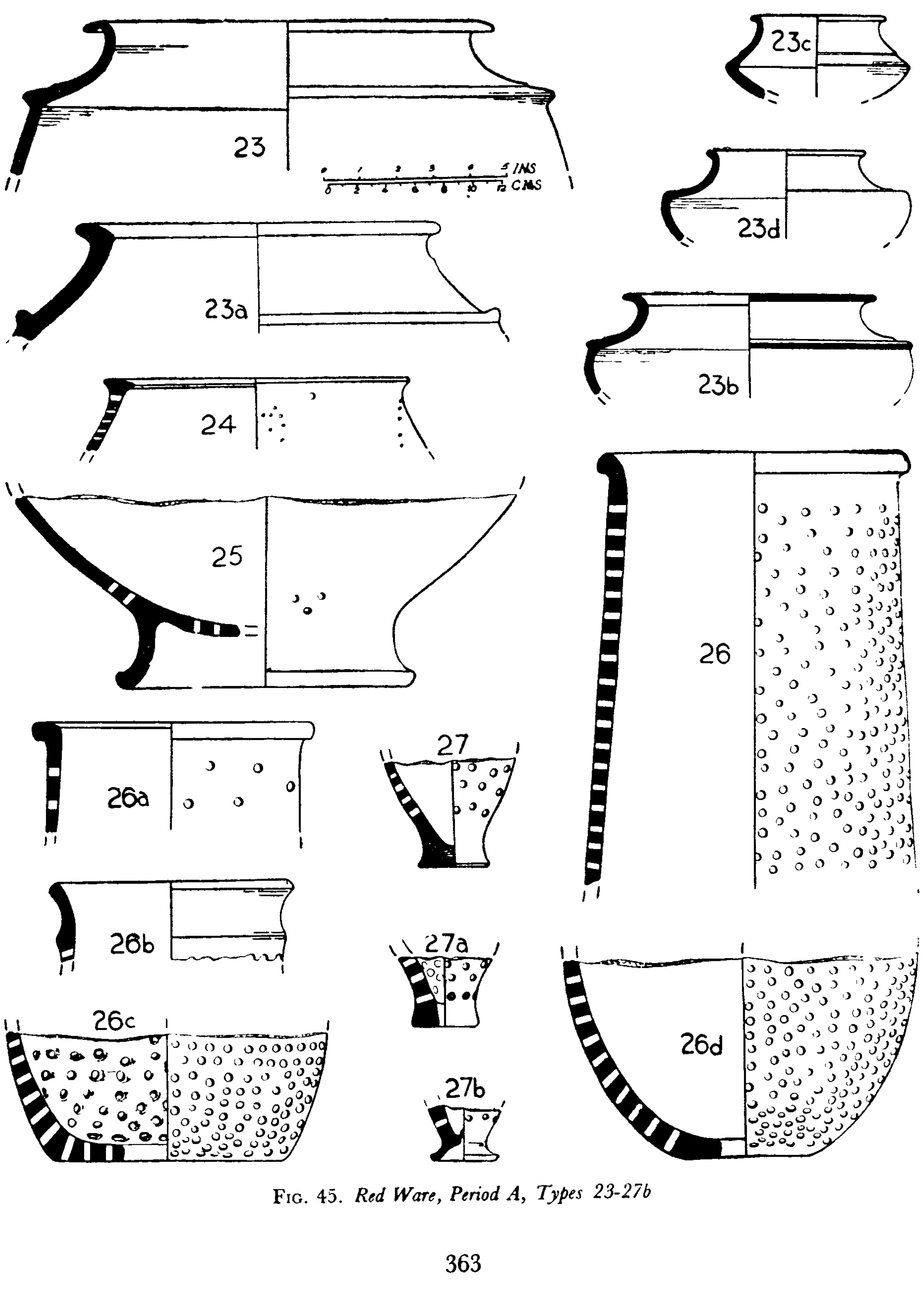

FIG. 45. *Red Ware, Period A, Types 23-27b*

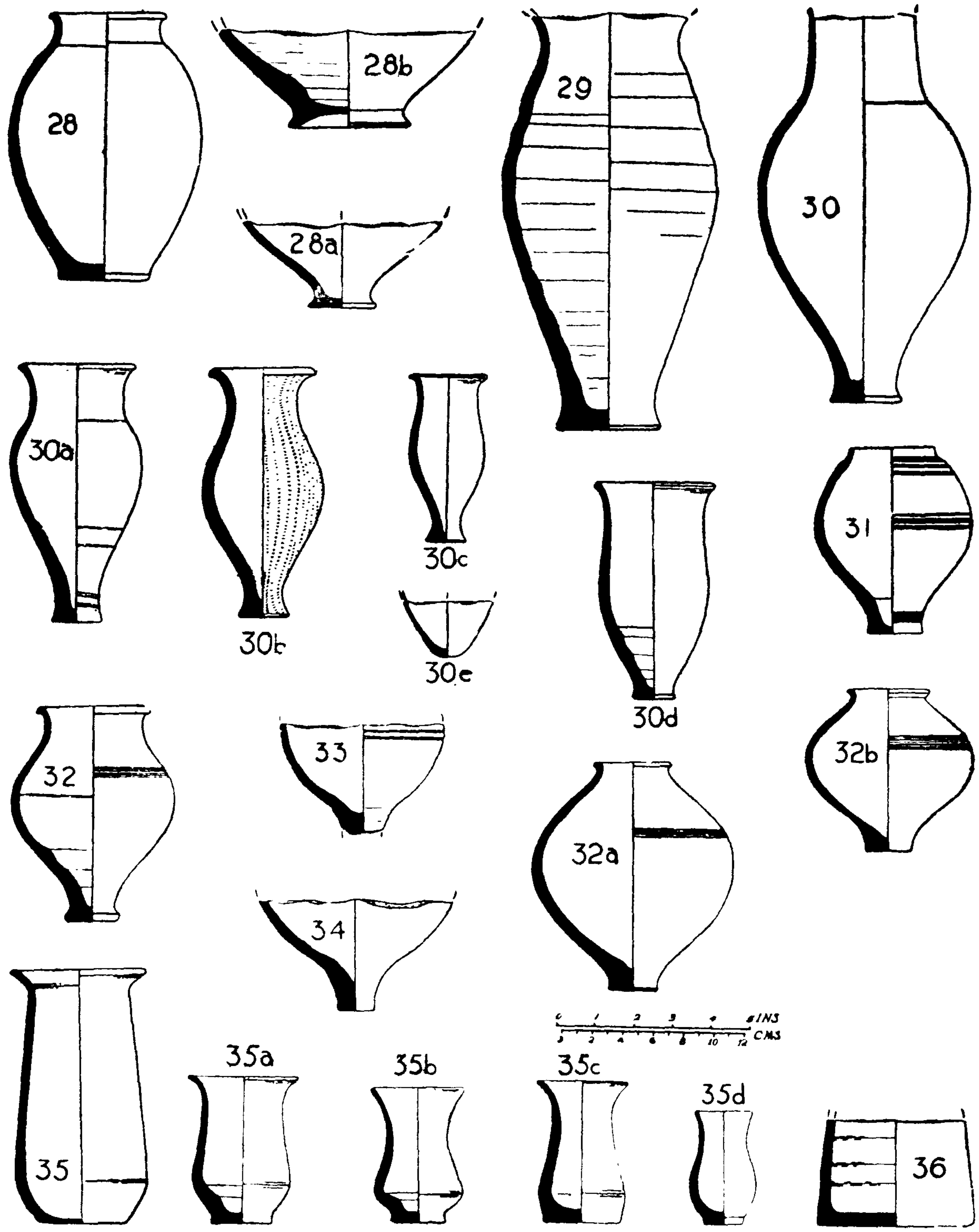

Fig. 46. *Red Ware, Period A, Types 28-36*

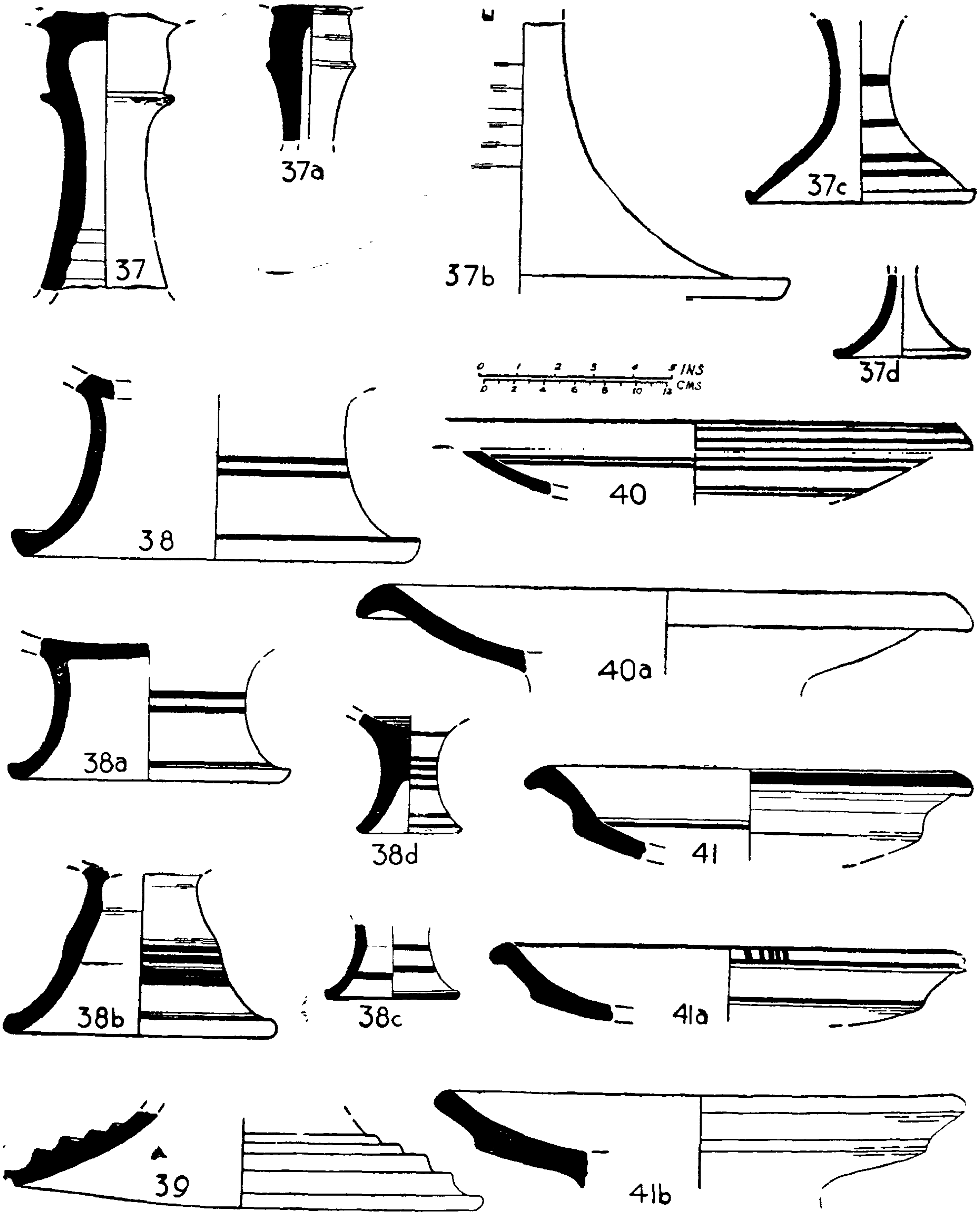

FIG. 47. *Red Ware, Period A, Types 37 to 41b*

Type 38. Thick squattish stem of a dish-on-stand of medium fabric with a beaded base. Painted in black ever deep-red with horizontal bands on the exterior. From late level. *Variant 38a,* small types of dish-on-stand. From surface. *Variant 38b,* with a beaded base. From late level. *Variant 38c,* miniature stem. From late level. *Variant 38d,* partially solid. Painted in black over red with horizontal bands on the stem and concentric bands on the interior. From late level Pl. CLXVIII A.

Type 39. Broad stem of a dish-on-stand of medium fabric with a deeply-corrugated exterior. Red slip applied on the exterior. From late level.

Type 40. Dish-on-stand of medium fabric with an everted rim. Painted in black over red with concentric bands on the interior and horizontal bands on the exterior. From early level. *Variant 40a,* with a projected rim. From late level.

Type 41. Dish-on-stand of medium fabric outturned rim, carinated shoulder and ledged interior. Painted in black over red with horizontal bands on the rim and concentric bands on the interior. From late level. *Variant, 41a,* with a short projected rim. Painted with oblique strokes between horizontal bands below. From late level. *Variant 41b,* with a featureless rim. From late level.

Fig. 48

Type 42. Dish-on-stand of medium fabric with a splayed out featureless rim and carinated shoulder, Red slip applied. From surface. *Variant 42a,* with a thick rim and less prominent carination.From late level. *Variant 42b,* with a prominent carination and splayed-out rim, thin fabric. From early level. *Variant 42c,* with a thick short rim. The stand must have been long and narrow. From middle level. *Variant 42d,* with a prominent carinated shoulder. From late level. *Variant 42e,* with a short thick rim. From middle level. *Variant 42f,* painted in black with loops on the rim, concentric bands on the interior and horizontal bands on the exterior. From middle and late levels. *Variant 42g,* with intersecting loops. From late level. *Variant 42h,* miniature dish. From late level. *Variant 42i,* with blunt carinated shoulder. From late level.

Type 43. Dish-on-stand of medium fabric with a raised edge and nail-headed rim. Red slip applied. From late level. *Variant 43a,* with an incurved rim. Painted with black horizontal bands on the exterior including the rim and concentric bands and oblique strokes on the exterior. From late level.

Type 44. Bowl on stand of medium fabric with splayed-out rim and sharp carinated shoulder. Painted in black over red with horizontal bands on both sides. From late level.

Type 45. Bowl of thin fabric with a ring-footed base. From late level.

Type 46. Dish of medium fabric with ring-footed base and nail-headed rim. Red slip applied on the interior. From late level.

Type 47. Dish of medium fabric with raised grooved sides, flaring rim, concave base and water-worn surface. From late levels.

Type 48. Shallow dish of medium fabric with a flat base and knife edged flaring rim. From late level.

Fig. 49

Type 49. Dish of medium fabric with an expanded rim. Red slip applied on the interior and exterior decorated with cord designs. From middle level. *Variant 49a* with an externally grooved projected rim and flat base. Red slip applied over buff wash. From late level. *Variant 49b,* with a carinated shoulder. From late level. *Variant 49c,* with a raised edge and projected rim. From surface. *Variant 49d,* with an externally beaded rim and flat base. From late level. *Variant 49e,* with an incurved rim and concave base. From early level. *Variant 49f,* with a beaded rim and flat base. From surface. *Variant 49g,* with a nail-headed rim and disc base. From early level. *Variant 49h,* with a rounded base and incurved rim. From middle level. *Variant 49i,* with a narrow flat base. From early level. *Variant 49j,* of small size, with a rounded base. Painted in black horizontal hands on the interior. From middle level. *Variant 49k,* with carination below the nail-headed rim. From middle level. *Variant 49l,* with a prominent nail-headed rim and painted on both the surfaces in black with horizontal bands and inverted loops. From middle level. *Variant 49m,* painted on the rim in black oblique lines. From middle level.

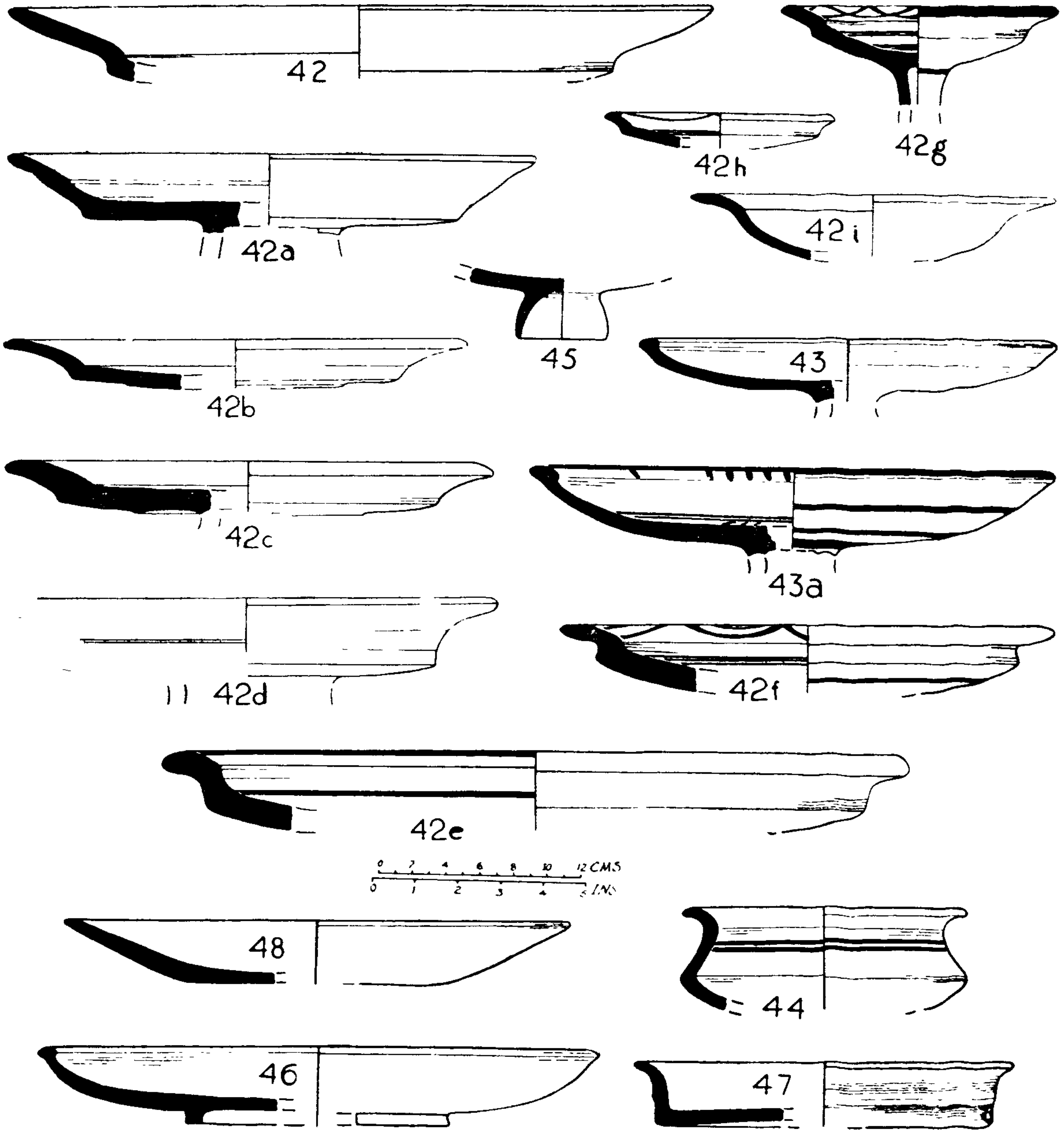

FIG. 48. *Red Ware, Period A, Types 42 to 48*

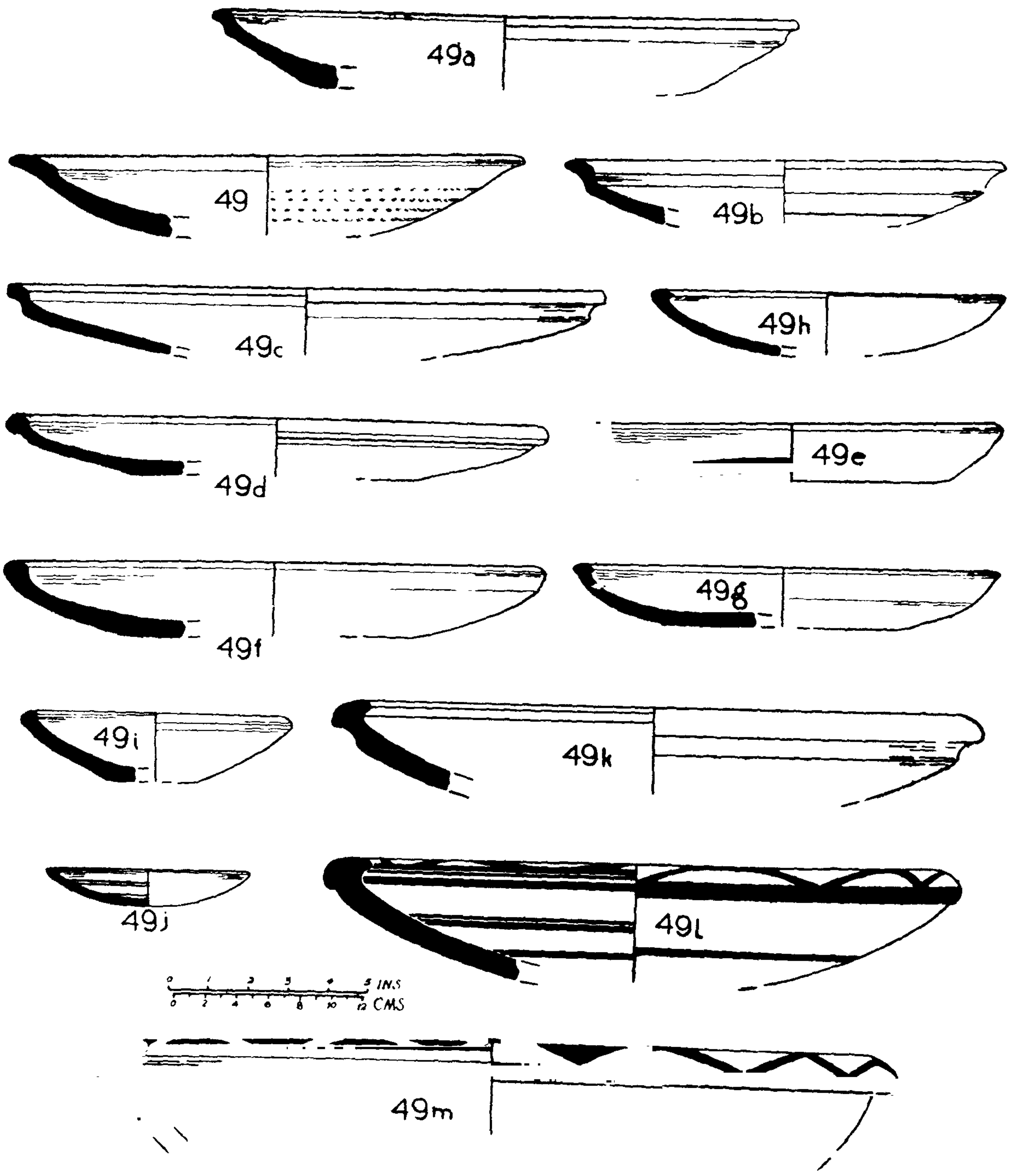

FIG. 49. *Red Ware, Period A. Types 49 to 49m*

Fig. 50

Type 50. Dish of medium fabric with a beaked rim and flat base. Painted in black over red with oblique strokes between loops, horizontal bands on the exterior and concentric bands on the interior. From late level. *Variant 50a,* with a thin projected rim. Red slip applied on the interior and a buff wash on the exterior. Concentric grooves on the interior. From late level. *Variant 50b,* with a short projected rim. From late level. *Variant 50c,* with an incurved projected rim. From surface. *Variant 50d. Variant 50e,* with an out-turned beaked rim and blunt carinated shoulder. From late and early levels.

Type 51. Basin of medium fabric with an incurved rim, tapering sides, and narrow flat base. From middle level.

Type 52. Basin of medium fabric with a projected rim and carinated shoulder. From late level.

Fig. 51

Type 53. Basin of medium fabric with a splayed out rim, concave sides, carinated shoulder and flat base. Bright red slip applied on both surfaces. From early level. *Variant 53a,* with an out-turned rim. From middle level. Pl. CLXVIII B, *1. Variant 53b,* with a sharp-edged projected rim. From middle level. *Variant 53c,* with a beaded rim. From late level. *Variant 53d,*

Type 54. Basin of medium fabric with a flaring mouth, convex sides and flat base. From late level.

Type 55. Basin of medium fabric with a flaring rim, carinated shoulder and ring-footed base. From late level.

Type 56. Basin of medium fabric with a straight featureless rim, ledged shoulder and ring-footed base. Red slip applied over a buff wash on the exterior. From middle level.

Type 57. Basin of medium fabric with convex sides and featureless rim. From late level.

Type 58. Basin of medium fabric with an incurved externally flanged rim, carinateds houlder, flat base and a hole below the rim. Red slip applied on the rough exterior. From late level. *Variant 58a,* with an externally-grooved rim and rounded lower portion. From late level.

Type 59. Basin-cum-dish of medium fabric with an obliquely-cut rim, convex sides and broad flat base. From middle level.

Type 60. Basin-cum-dish of medium fabric with an obliquely-cut rim and straight sides. From late level. *Variant 60a,* painted in black over red with horizontall ines on the exterior. From late level. *Variant 60b,* shallow and unpainted. From late level. *Variant 60c,* with a sagger base and everted rim. Painted in black over red with horizontal bands on the exterior. From late level. *Variant 60d,* with a carinated shoulder and tapering lower portion. From late level. *Variant 60e,* shallow dish with straight sides. From late level. *Variant 60f,* with carination near the base. *Variant 60g,* with everted rim and carinated shoulder.

Fig. 52

Type 61. Bowl of medium fabric with an everted rim, convex sides and flat base. Red slip applied on the exterior. From late level. *Variant 61a,* with a thick projected rim. From middle level. *Variant 61b,* of thin fabric and larger size. From late level. *Variant 61c,* with an everted rim flanged internally and a bulbous body. From middle level. *Variant 61d,* with a flaring rim, painted in black with oblique strokes on the interior and horizontal bands on the rim and shoulder on the exterior. From middle level. *Variant 61e,* of thin fabric with a flaring rim and carinated shoulder. From middle level. *Variant 61f,* bowl with an everted rim and flat base. From late level.

Type 62. Bowl of thin fabric with a flaring mouth, carinated shoulder and flat base. From middle level.

Types 63. Bowl of medium fabric with a flaring mouth, under-cut rim, convex sides and flat base. From late level.

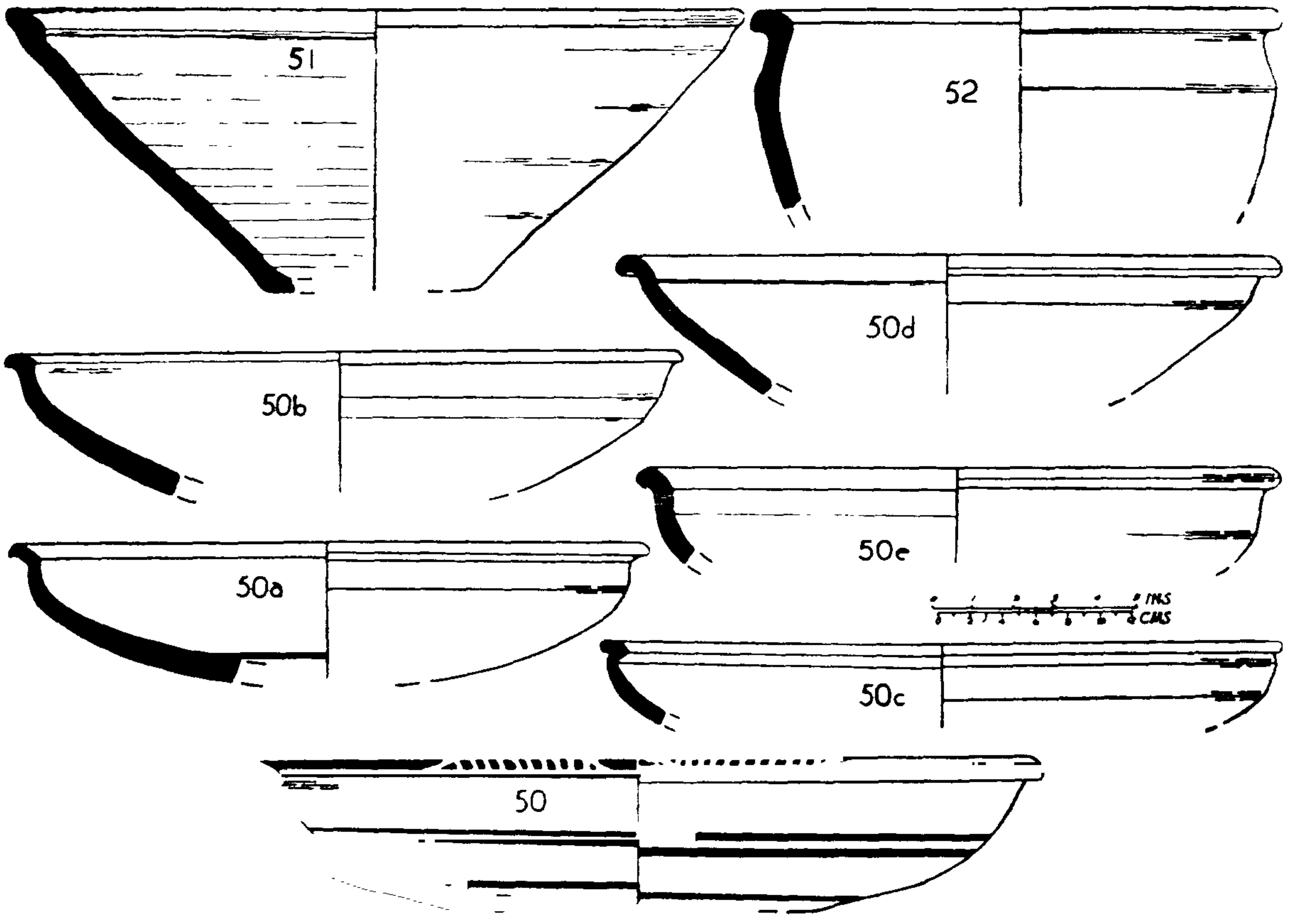

FIG. 50. *Red Ware, Period A, Types 50 to 52*

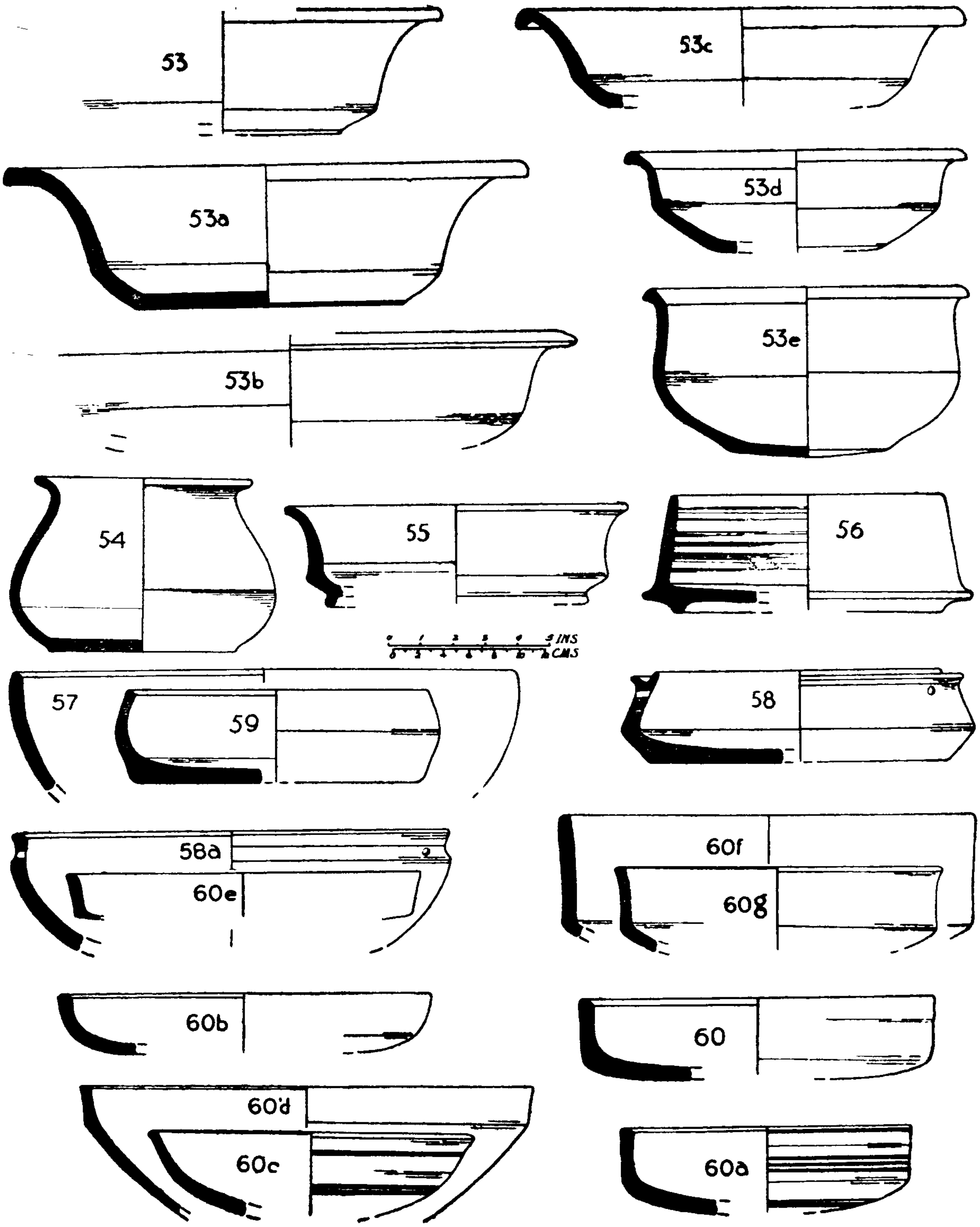

FIG. 51. *Red Ware, Period A, Types 53 to 60g*

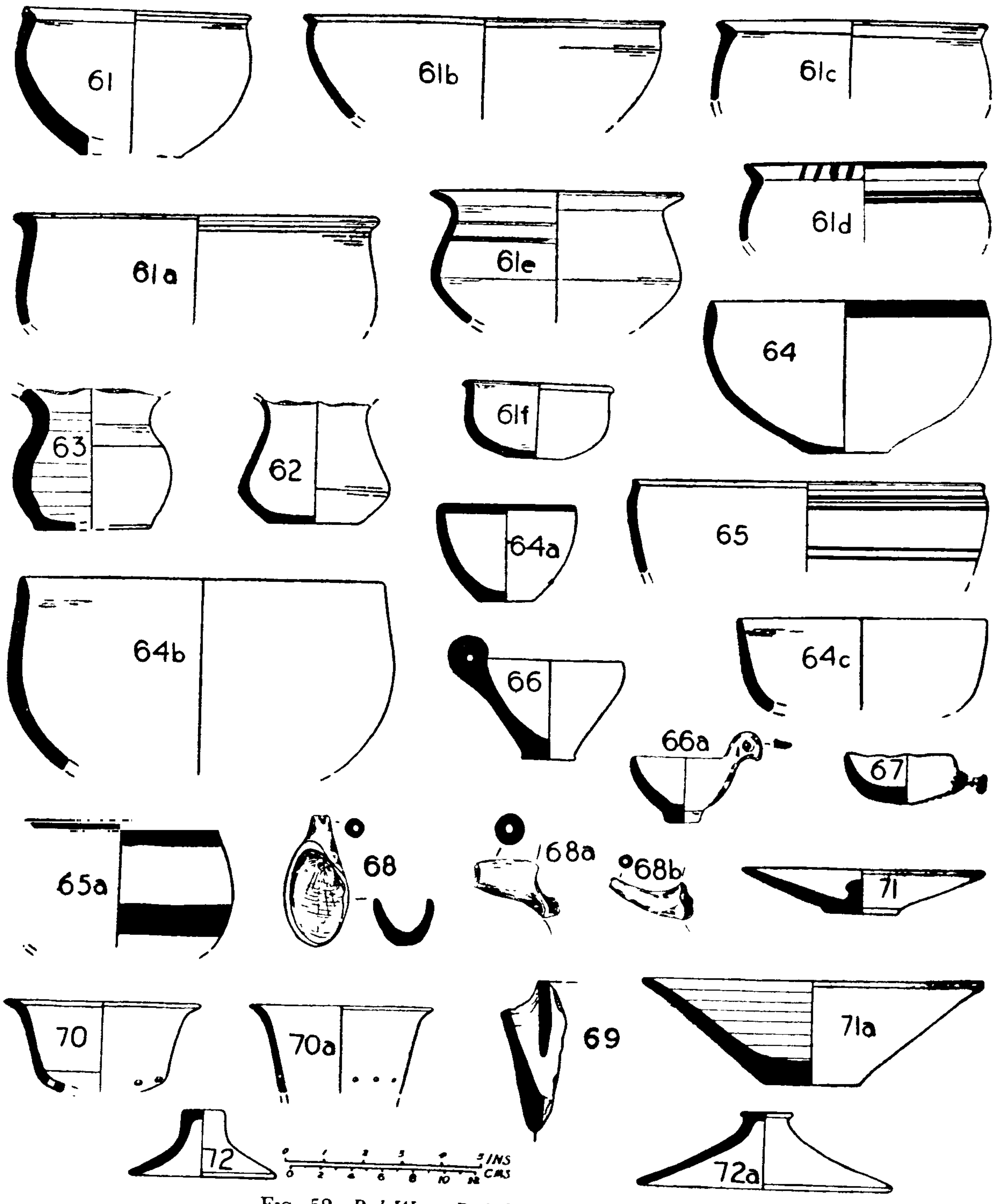

FIG. 52. *Red Ware, Period A, Types 60 to 72a*

Type 64. Bowl of medium fabric with convex sides, featureless rim and flat base. Dark-red slip applied over a buff wash on the interior and on the upper half of the exterior producing a light chocolate shade. Rim painted in chocolate with a horizontal band. From late level. *Variant 64a,* painted in black with a horizontal band on the rim. From late level. *Variant 64b,* with straight sides, carinated shoulder and slightly everted rim. From late level. *Variant 64c,* with a flaring shoulder and water-worn surface. From surface.

Type 65. Bowl of thin fabric with everted under-cut rim and convex sides. Painted in black over red with horizontal lines on the exterior. From late level. *Variant 65a,* with an obliquely-cut grooved rim and convex sides. Painted in crimson red over ashy matt surface with two broad bands. From late level.

Type 66. Cup of medium fabric with convex sides, pedestal base, pinched perforated handle and smoky interior. From late level. Pl. CLXVIII C, *1. Variant 66a,* with an incurved rim and beaked handle. From late level. Pl. CLXVIII C, *2.*

Type 67. Small lamp with featureless rim and perforated handle. From late level.

Type 68. Feeding-cup with a spout. From late level. Pl. CLXVIII C, *4. Variant 68a,* small spout. Painted in black over red. From surface. *Variant 68b,* long and thin. From late level.

Type 69. Spout of a small jug. From late level.

Type 70. Strainer-like pot of thin fabric with a flaring rim and perforated bottom. From late level. *Variant 70a,* with perforated sides. From late level.

Type 71. Lid of medium fabric with a sharp-edged rim, flat base and a knob on the interior. Slip almost flaked off. From late level. *Variant 71a,* with no knob. From middle level.

Type 72. Lid of medium fabric with an internally hollow knob-handle. From late level. *Variant 72a,* with a short knob. From late level.

Fig. 53

Type 73. Lid of medium fabric with an internally-hollow knob and flanged base. Red slip on the exterior almost flaked off. From late level. *Variant 73a,* with an elongated lower flange having holes in the sides. From late level. *Variant 73b,* with a broad base. From level. *Variant 73c,* with a thick solid knob on the top. From late level.

Type 74. Lid with flat rim and perforated sagger base. From late level.

Type 75. Funnel-shaped pot with a broad base and a pipe. Ball-moulding and ribs near the top of the the pipe. From late lavel. *Variant 75a,* with an expanded base. Painted in black over dull-red with horizontal bands. From late level.

Type 76. Ring stand of medium fabric with a beaded rim. From late level. *Variant 76a,* of larger size. From middle level . *Variant 76b,* with a beaded base. From middle level. *Variant 76c.* with a projected rim. From middle level.

Type 77. Drain-pipe with a ledged rim and cylindrical sides. From late level. *Variant 77a,* with flanged shoulder. From late level. *Variant 77b,* with a grooved end. From late level.

(ii) *Buff-slipped Ware.*

It is identical in forms with the Red Ware but treated with a buff-slip. As the vessels are fired under completely oxidising conditions, the core is reddish. Most of them were dipped in a thin yellow liquid, but in a few cases a red ochre wash was given on the interior and a yellow one on the exterior. A yellow slip on exterior is rare. A couple of vessels fall into the bichrome group, the pigments used being red and black. It must be noted here that the buff-slipped ware is common to most of the Harappan sites in Gujarat and occurs in small quantities at Mohenjo-daro. Its complete absence in the more northerly sites such as Kalibangan, Harappa, Rupar and Alamgirpur is significant.

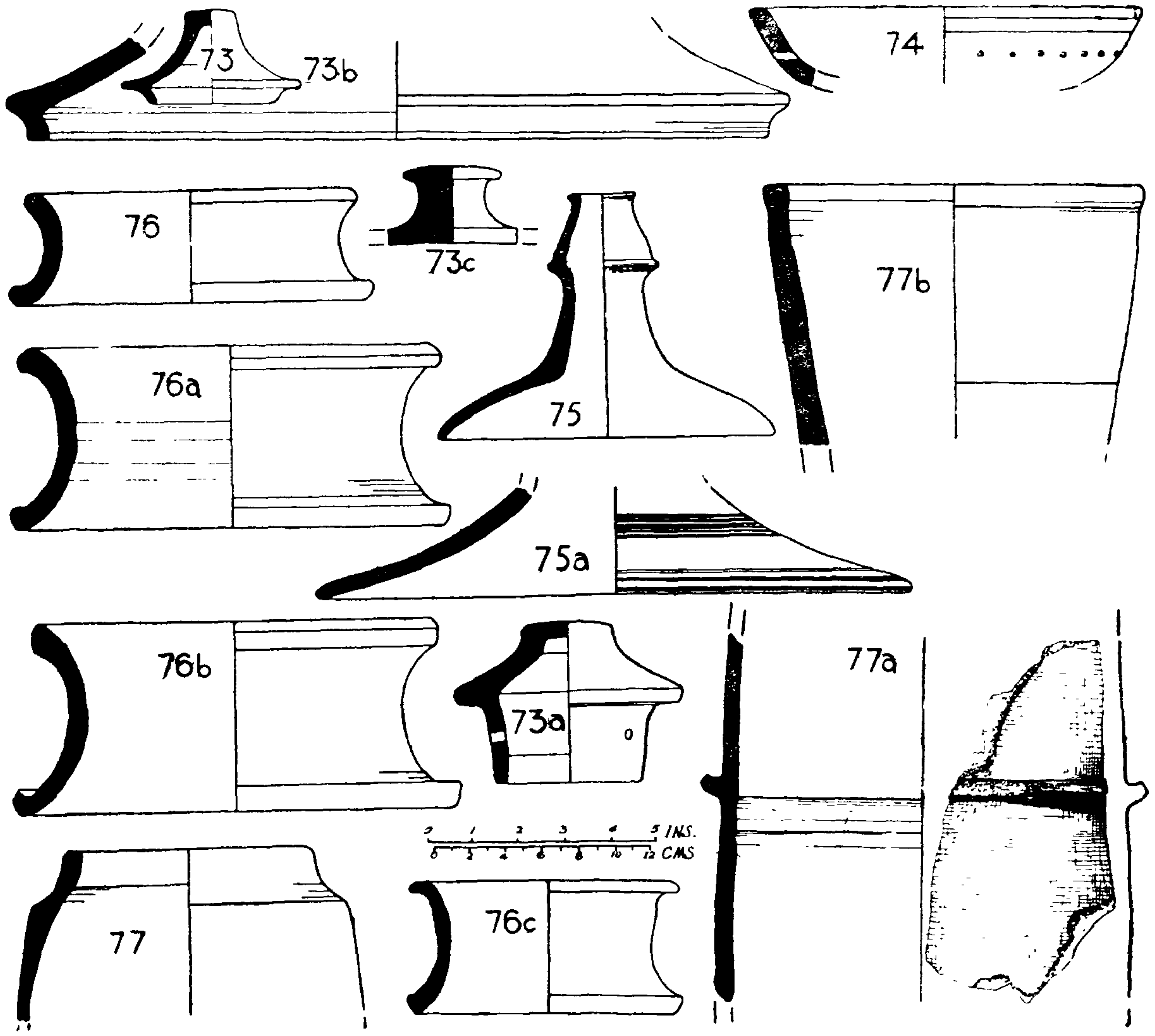

FIG. 53. *Red Ware, Period A, Types 73 to 77b*

Fig. 54

Type 78. Large storage-jar of thick fabric with a beaked rim and ledged shoulder. Buff-slip applied on the exterior. From late level. *Variant 78a,* with an ovoid body. From late level.

Type 79. Storage-jar of medium fabric with a narrow mouth, beaked rim, ribbed shoulder and globular body. Painted in black over red with horizontal bands over a buff wash above the shoulder. From late level.

Type 80. Large storage-jar of thick fabric with a beaked rim, wide mouth, ledged shoulder and ovoid body. Green buff-slip applied. From late level. *Variant 80a,* with a clubbed rim. Painted in black over red slip. From late level. *Variant 80b,* with an externally collared rim. From late level.

Type 81. Bottom of a storage-jar of thick fabric with a concave base. Buff-slip applied on the exterior. From late level.

Type 82. Storage-jar of medium fabric with an externally projected rim and ovoid sides. Chocolate slip applied over a buff wash on the exterior. From middle level. *Variant 82a,* with a beaked rim and convex sides. From late level. *Variant 82b,* with a clubbed rim. From late level.

Fig. 55

Type 83. Basin of medium fabric with flanged rim, concavo-convex profile, flat base and holes below the rim. Painted in chocolate over buff with horizontal bands. From late level. Pl. CLXIX A. *Variant 83a,* with a flanged rim. From late level. *Variant 38b,* with an internally-flanged rim. From late level.

Type 84. Squattish jar of medium fabric with a flaring mouth, beaked rim, concavo-convex profile and a flat base. From late level.

Type 85. Jar of medium fabric with an incurved obliquely-cut mouth and bulbous body. From late level.

Type 86. Jar of medium fabric with a projected out-turned rim, grooved shoulder and ovoid body. From late level. *Variant 87a,* with a beaded rim. Painted in black over red with a horizontal band at the neck. From late level. *Variant 87b,* with a beaded rim and bulbous body. From middle level. *Variant 87c,* with a beaked rim. From late level. *Variant 87d,* with an everted rim. From middle level. *Variant 87e,* with a beaded rim and slightly raised neck. Painted in crimson over buff with horizontal bands. From late level. *Variant 87f,* with a projected rim and slightly raised neck. From late level. *Variant 87g,* with a beaded rim and corrugated profile. From late level.

Fig. 56

Type 88. Jar of medium fabric with a beaded rim, short neck, globular body and narrow flat base. From late level.

Fig. 57

Type 89. Jar of thin fabric with a flaring mouth, flat everted rim and ovoid body. From late level. *Variant 89a,* with a globular body. From late level. *Variant 89b,* with a thick, projected rim and raised neck. From late level.

Type 90. Jar of thin fabric with a flaring mouth, out-curved rim, high neck, globular body and flat base. Painted in black over red with horizontal bands. From late level. *Variant 90,* with a small globular body. Pared bands. From late level.

Type 91. Small jar with an out-turned rim and pedestal base. From surface.

Type 92. Neck of jar with constricted mouth, beaded rim and concave neck. Painted in crimson over buff with cross bands on the top of mouth. From late level.

Type 93. Jar of medium fabric with a beaked rim, ribbed shoulder and grooved interior. Chocolate slip applied over buff wash. From middle level. *Variant 93a,* squattish miniature jar with a flared rim and carinated shoulder. From late level. *Variant 93b,* with a projected rim and ridged shoulder. From late level.

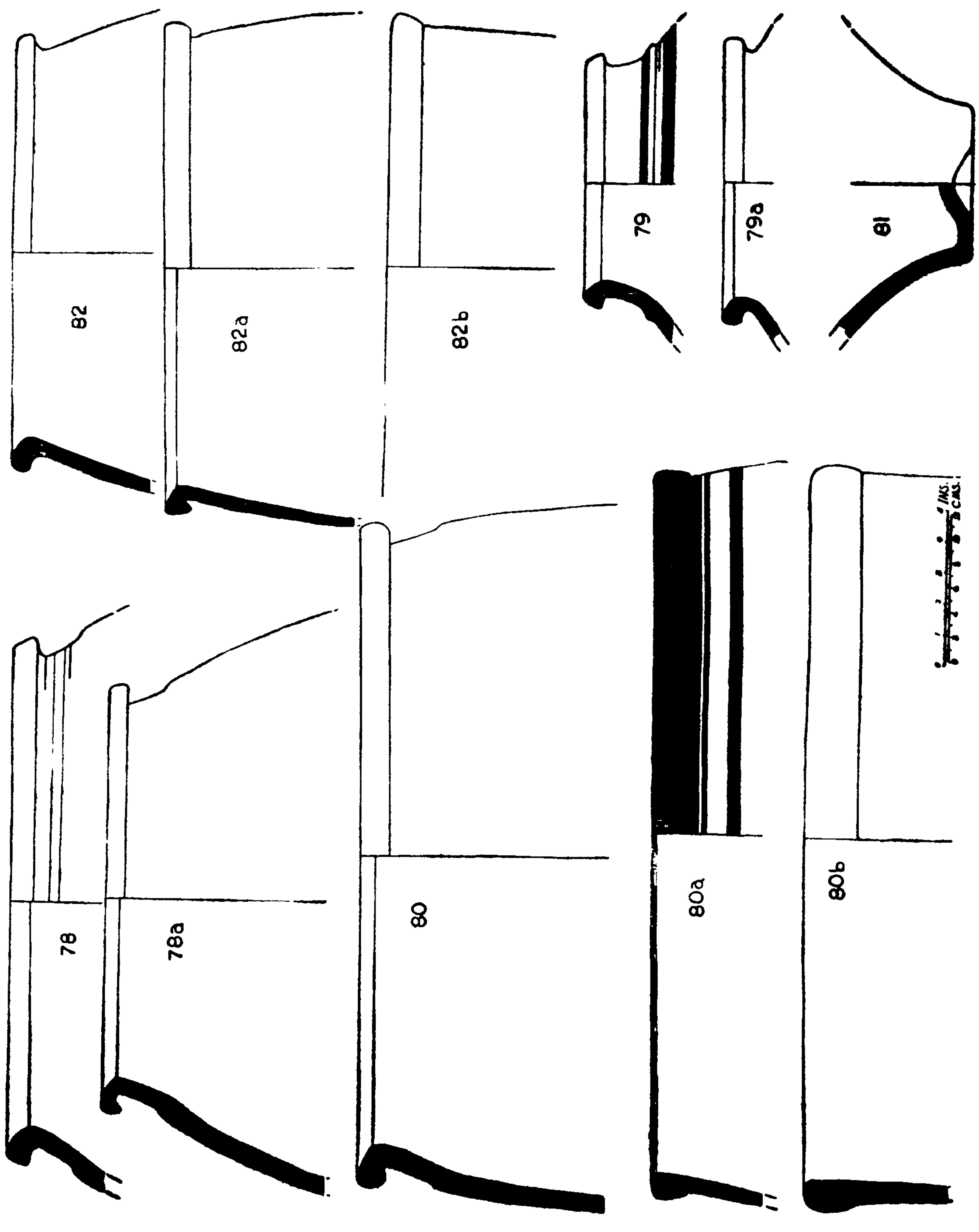

FIG. 54. *Buff-slipped Ware, Period A, Types 78 to 82b*

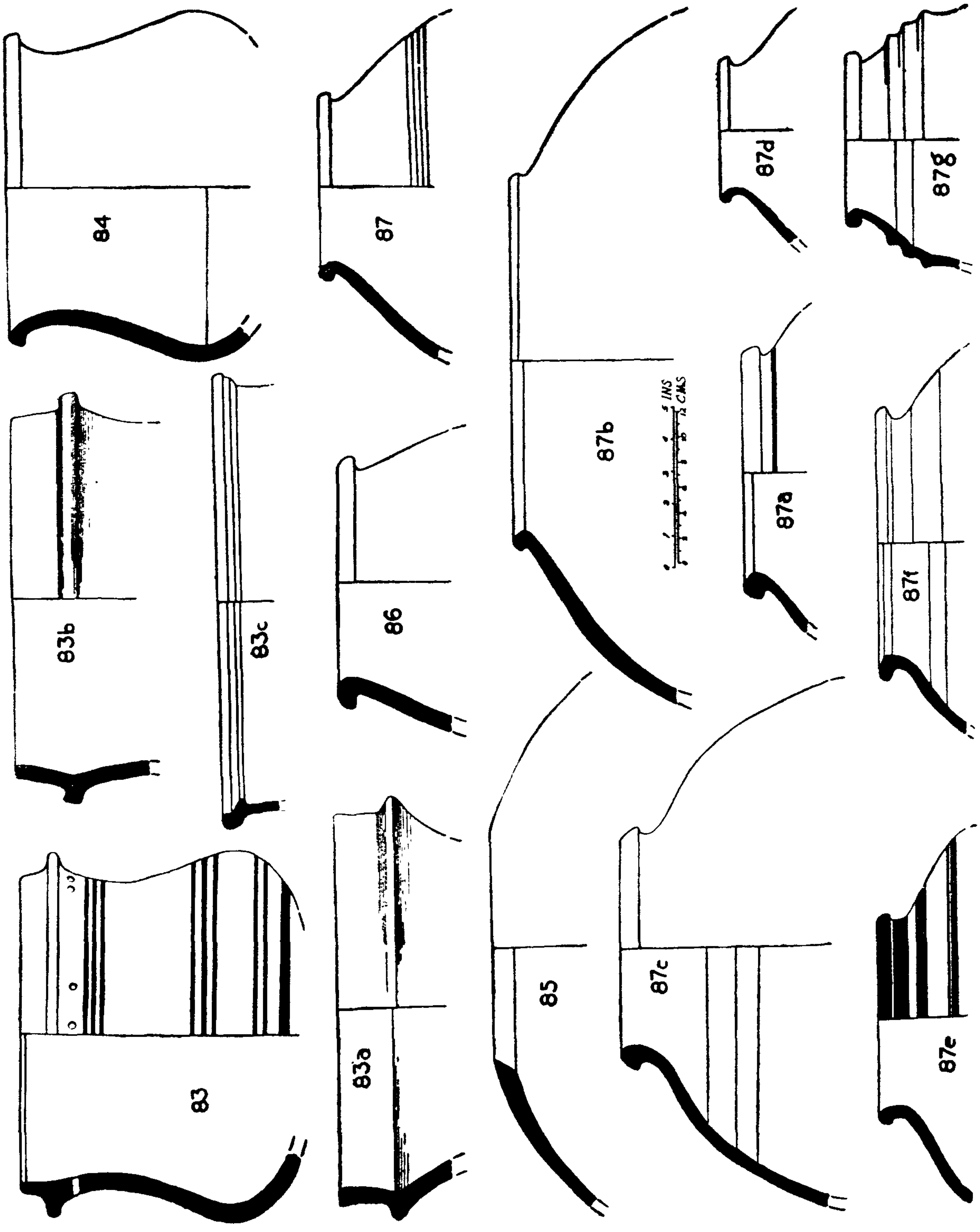

Fig. 55. *Buff-slipped Ware, Period A, Types 83 to 87g*

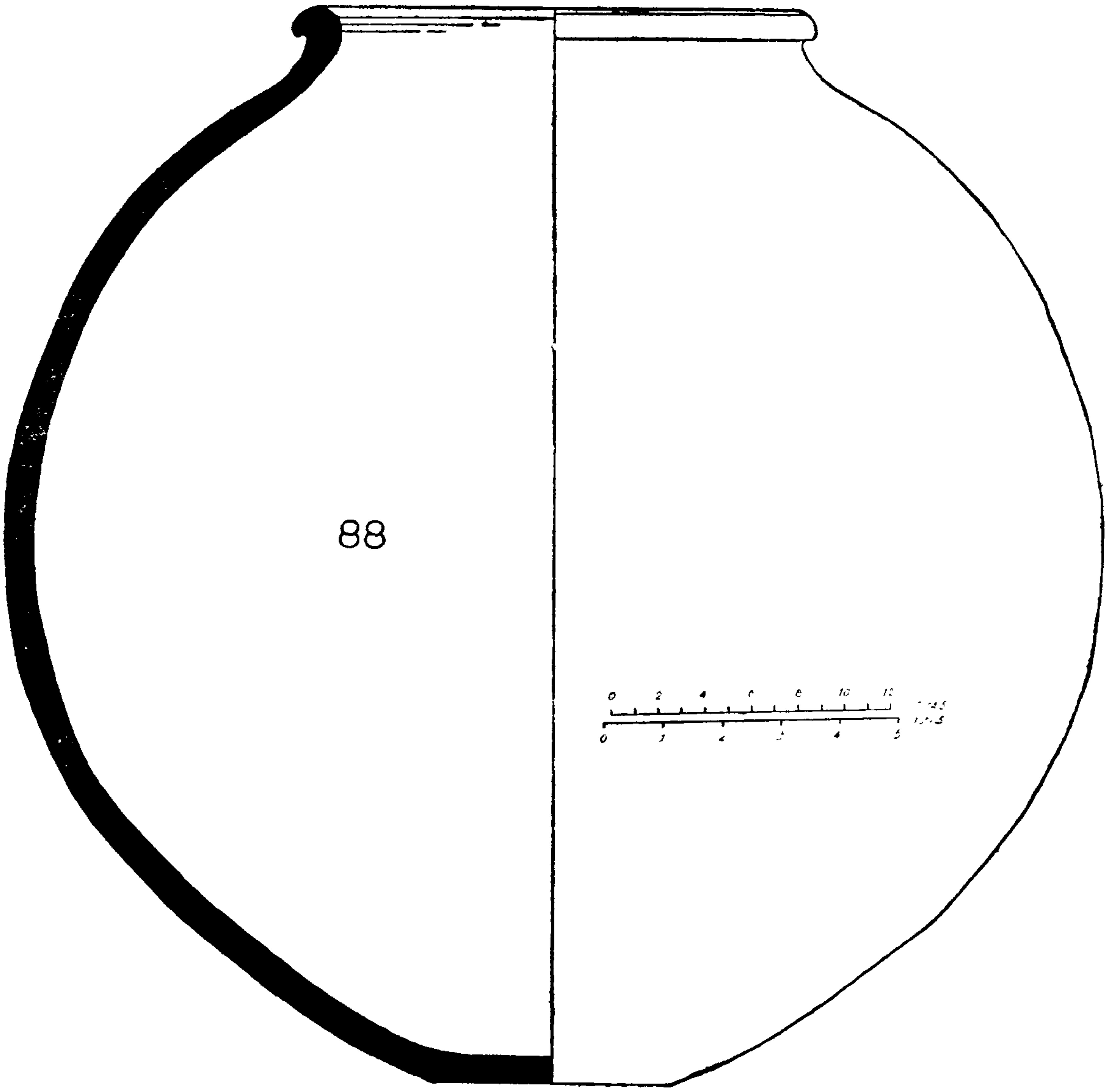

FIG. 56. *Buff-slipped Ware, Period A, Type 81*

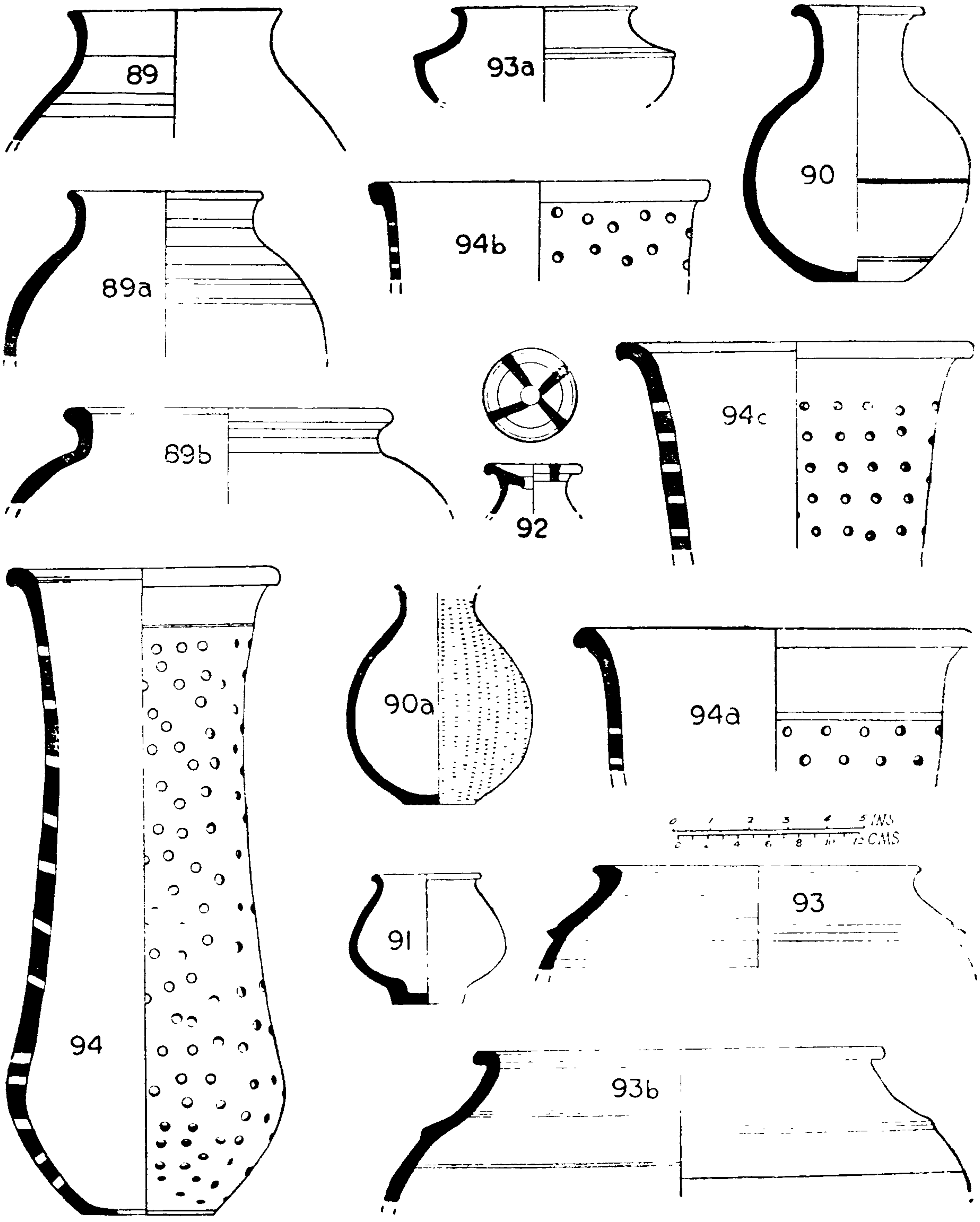

FIG. 57. *Buff-slipped Ware, Period A, Types 89-94c*

Type 94. Cylindrical perforated jar of medium fabric with a projected rim, grooved shoulder and disc base with a hole in the centre. Red patches are visible on the exterior on account of differential firing. From late level. Pl. CLXIX C. *Variant 94a*, with a beaded rim. From middle level. *Variant 94b,* with a flat projected rim of thin fabric. From early level. *Variant 94c.* with slightly beaded rim and a flaring mouth. From middle level.

Fig. 58

Type 95. Vase of medium fabric with a raised neck, elongated body, footed base and grooved on the exterior. From surface. *Variant 95a,* with a beaded base. From late level. *Variant 95b,* with a narrow flat base. From middle level. *Variant 95c,* with a squattish broad base. From middle level. *Variant 95d,* with thin wall. From middle level. *Variant 95e,* with a bulbous body. From middle level. *Variant 95f,* with a flat base. From early level.

Type 96. Goblet with an ovoid body and pointed footed base. From late level. *Variant 96a,* with an eliptical body. From late level.

Type 97. Goblet of medium fabric with a flaring mouth, eliptical body, pointed base, stroked shoulder and grooved interior. From late level. *Variant 97a,* with a narrow mouth, globular body and footed base. From late level.

Type 98. Beaker of thin fabric with flaring mouth and disc base bearing string marks. Buff wash applied on the exterior. From late level. *Variant 90a,* with a slightly broad base. Squattish. From early level. Pl. CLXVI B, *3*. *Variant 98b,* with a broad belly. Squattish. From middle level. Pl. CLXVI B, *4*.

Type 99. Stem of dish-on-stand of medium fabric with a beaded base. Painted in chocolate over buff with a horizontal band on the exterior. From late level. *Variant 99a,* with a broad base. From late level.

Type 100. Bowl-on-stand of medium fabric with a plain elongated stem. Buff wash applied. From middle level. *Variant 100a,* miniature stem of bowl-on-stand. Red slip applied over a buff-wash. From surface.

Type 101. Squattish stem of dish-on-stand of medium fabric with a beaded rim. From late level.

Type 102. Dish of thick fabric with a projected rim. Brown slip applied over buff. Painted with chocolate concentric bands on the interior. From late level.

Type 103. Dish of medium fabric with splayed-out rim, carinated shoulder and water-worn surface. From late level. *Variant 103a,* with a blunt rim and sharp carinated shoulder. From late level. *Variant 103b,* dish with a ridge on the shoulder. Painted in black over brown slip with a horizontal band on the exterior. From late level.

Type 104. Shallow dish of thin fabric with a raised sharp-edged rim and flat base. Buff slip applied on both sides. From late level. *Variant 104a,* thick and broad base. From late level.

Fig. 59

Type 105. Dish of medium fabric with a nail-headed rim and broad flat base. Buff slip applied on the exterior and red on the interior. From middle level. *Variant 105a,* with a short projected rim, blunt-carinated shoulder, flat base and rough surface. From late level. *Variant 105b,* with a ring-footed base. From late level. *Variant 105c,* with a thick base. From late level. *Variant 105d,* with ani nternally projected rim. Shallow. From late level. *Variant 105e,* with a flaring blunted rim. From middle level. *Variant 105f,* with a beaded rim and flat base. From late level. *Variant 105g,* with a projected rim and grooved exterior. Has two holes. From late level.

Type 106. Dish of medium fabric with straight sides and flat base. From middle level. *Variant 106a,* with an everted rim and blunt-carinated shoulder. From late level.

Type 107. Basin of medium fabric with a nail-headed rim, blunt-carinated shoulder and narrow flat base. From late level. Pl. CLXVIII B, *2*. *Variant 107a,* with a differently shaped rim. From late level. *Variant 107b* broad. From middle level. *Variant 197c,* with shallow broad base. From surface. *Variant 107d,* with a projected rim and grooved interior. From late level.

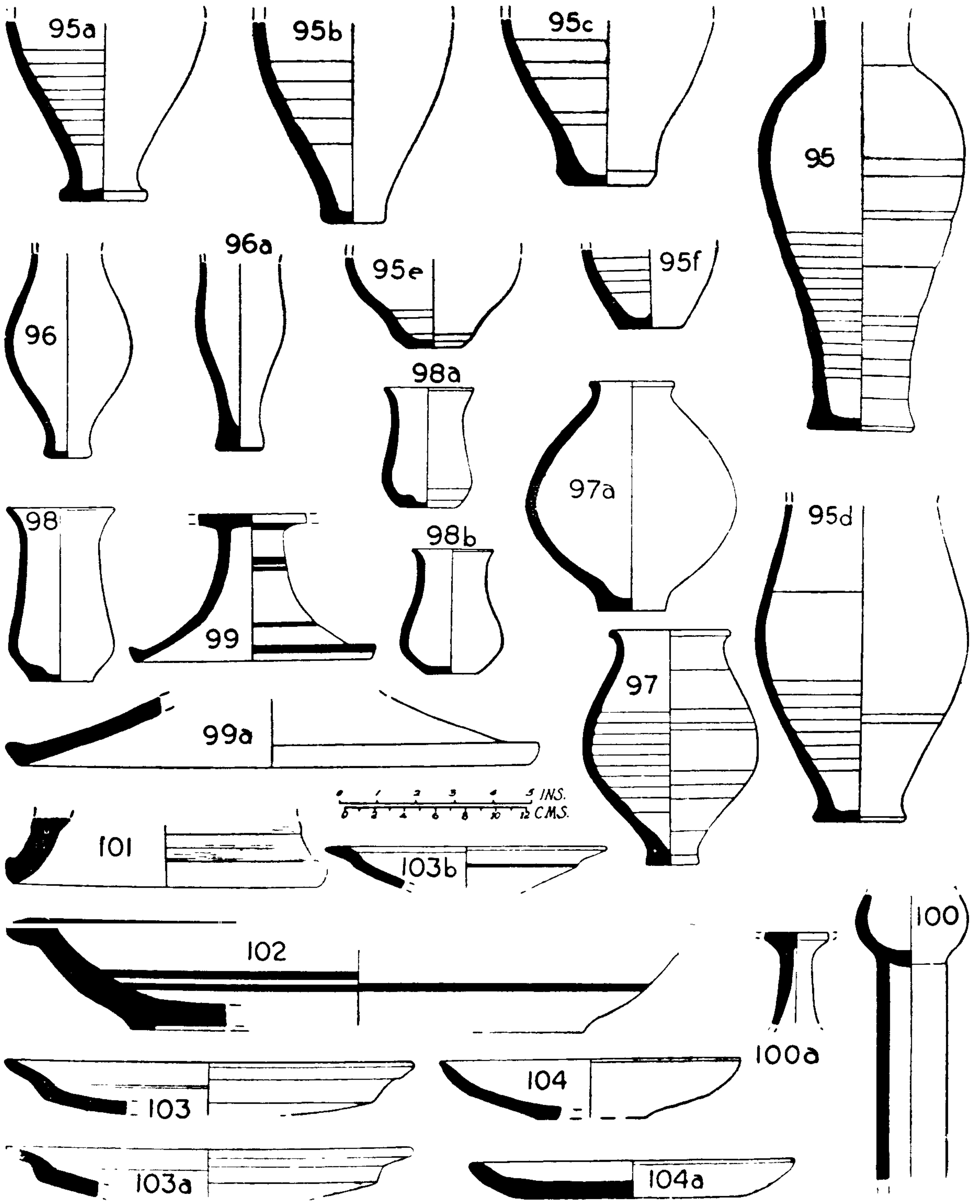

FIG. 58. *Buff-slipped Ware, Period A, Types 95 to 104a*

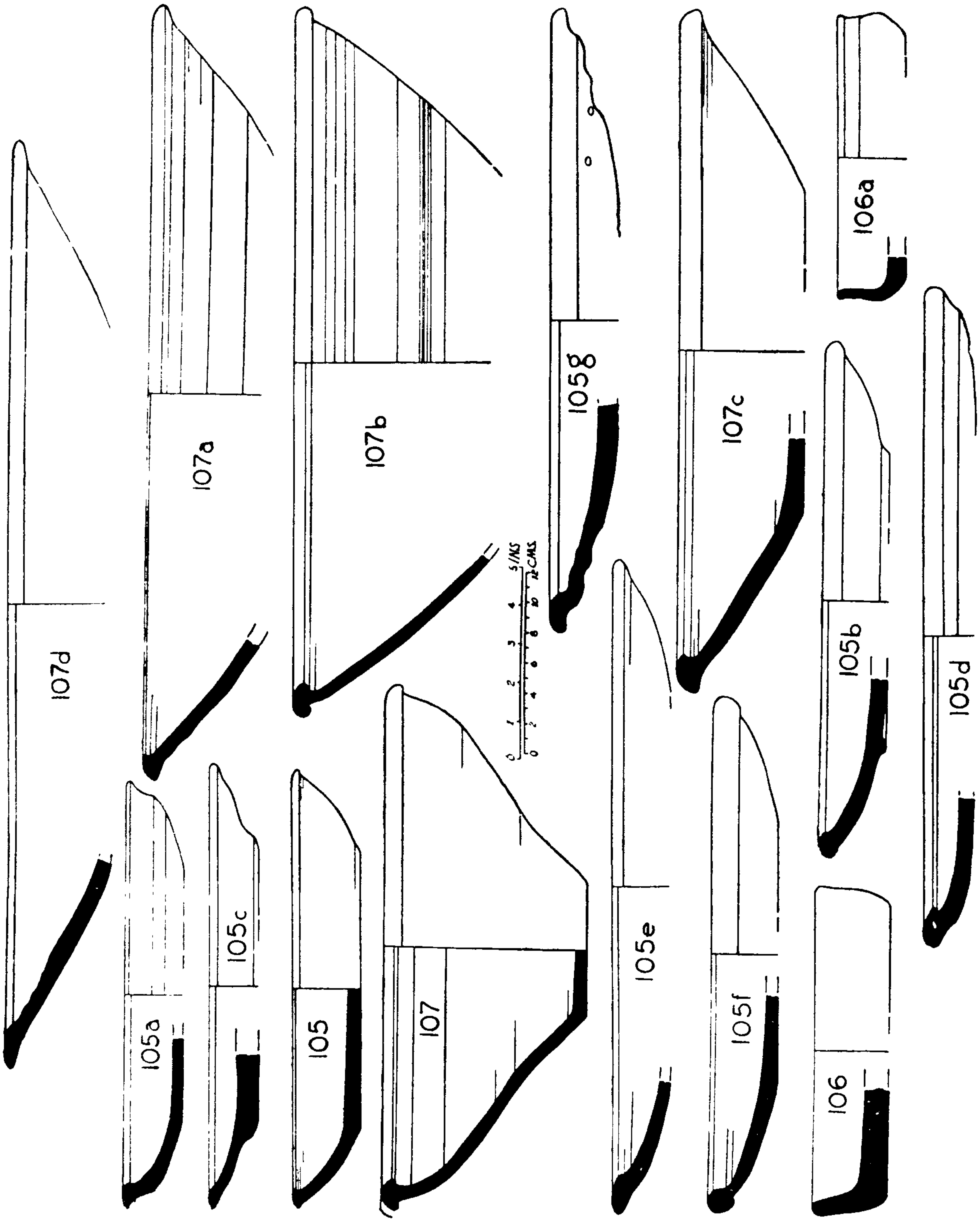

FIG. 59. *Buff-slipped Ware, Period A, Types 105-107d*

Fig. 60

Type 108. Basin of medium fabric with a flat projected rim and blunt carinated shoulder. Incised cord design on the exterior. From surface. *Variant 108a,* with a thick projected rim. From late level.

Type 109. Basin of medium fabric with a splayed-out rim, blunt-carinated shoulder and broad flat base. From late level. *Variant 109a,* with an externally projected rim. From middle level. *Variant 109b,* with a prominently projected rim and flaring mouth. From middle level. *Variant 109c,* with a beaked rim and thin walls. From early level.

Type 110. Basin of medium fabric with a beaked rim and blunt-carinated profile. From middle level. *Variant 110a,* with a projected slightly-beaded rim. From late level.

Type 111. Basin of medium fabric with an obliquely cut-rim, straight sides and flat base. Buff and red slips partially applied on the exterior. From late level. *Variant 111a,* with a projected rim and carinated shoulder. Squattish. From middle level.

Type 112. Large bowl of medium fabric with a featureless rim and convex sides. From late levels.

Type 113. Bowl of thin fabric with a featureless rim and convex sides. Red slip applied over buff surface on the interior. Painted in chocolate with horizontal band on the rim. From late level. *Variant 113a,* of small size with convex sides and flat base. Painted in chocolate over light-brown slip with horizontal bands on the exterior. From late level.

Type 114. Bowl of thin fabric with a projected rim, straight sides and slightly-carinated belly. Almost resembles a basin. From late level. *Variant 114a,* with a prominent projected rim, convex sides and a broad flat base. Painted with chocolate horizontal bands on the interior. Buff slip applied on the exterior. From late level.

Fig. 61

Type 115. Bowl of thin fabric with a flanged grooved rim and convex sides. From late level.

Type 116. Cup of thin fabric with a pinched perforated handle and possibly footed base. Hand-made. Buff wash applied. From late level. *Variant 116a,* with a large circular perforated handle. Crude workmanship. From late level.

Type 117. Cup of thin fabric with an incurved rim, and narrow footed base. Rough exterior bearing finger-marks. From middle level. *Variant 117a,* with a broad flat base. Traces of a handle visible. From late level.

Type 118. Lid of thin fabric with a knife edged rim, flaring sides and flat base. From late level. *Variant 118a,* of small size with a narrow base. From late level.

Type 119. Lid of thin fabric with a slightly projected rim, flat base and a knob in the centre of the base on the interior. From middle level. *Variant 119a,* of large size. Small central knob. From early level. *Variant 119b,* with a splayed rim and straight sides. Traces of knob visible.

Type 120. Lid of thin fabric with knife-edged base and flat top. From middle level.

Type 121. Bowl-like-lid of thin fabric with an incurved featureless rim and flat projected base. Perforated wall. Buff slip applied on the exterior. From late level.

Type 122. Lid of medium fabric with a broad flanged base and receding sides. From late level.

Type 123. Votive lamp of medium fabric with three concentric walls joined by a cross wall. Marks of soot on two of the walls and traces of lip for the wick visible. Hand made. From late level. Pl. CLXIX B. Also occurs at Ur.

Type 124. Ring-stand of medium fabric with concave sides. From late level. *Variant 124a,* of large size. Painted with thick black band on the exterior. From late level. *Variant 124b,* with beaked rim. From late level. *Variant 124c,* of large size with a beaded rim. *Variant 124d,* of miniature size with a featureless rim. From middle level.

Type 125. Ring-stand (?) with rounded shoulder. From middle level.

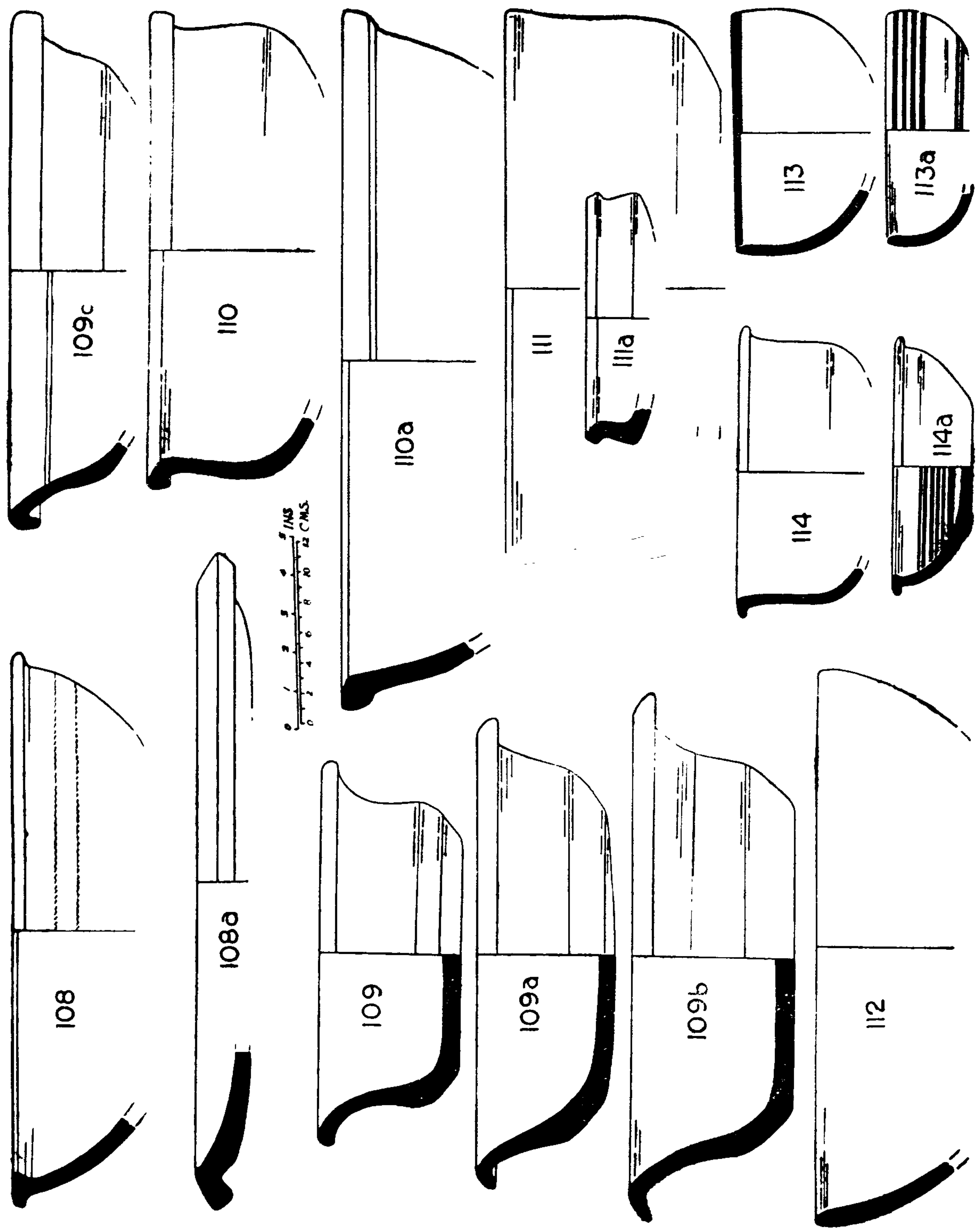

FIG. 60. *Buff-slipped Ware, Period A, Types 108-114a*

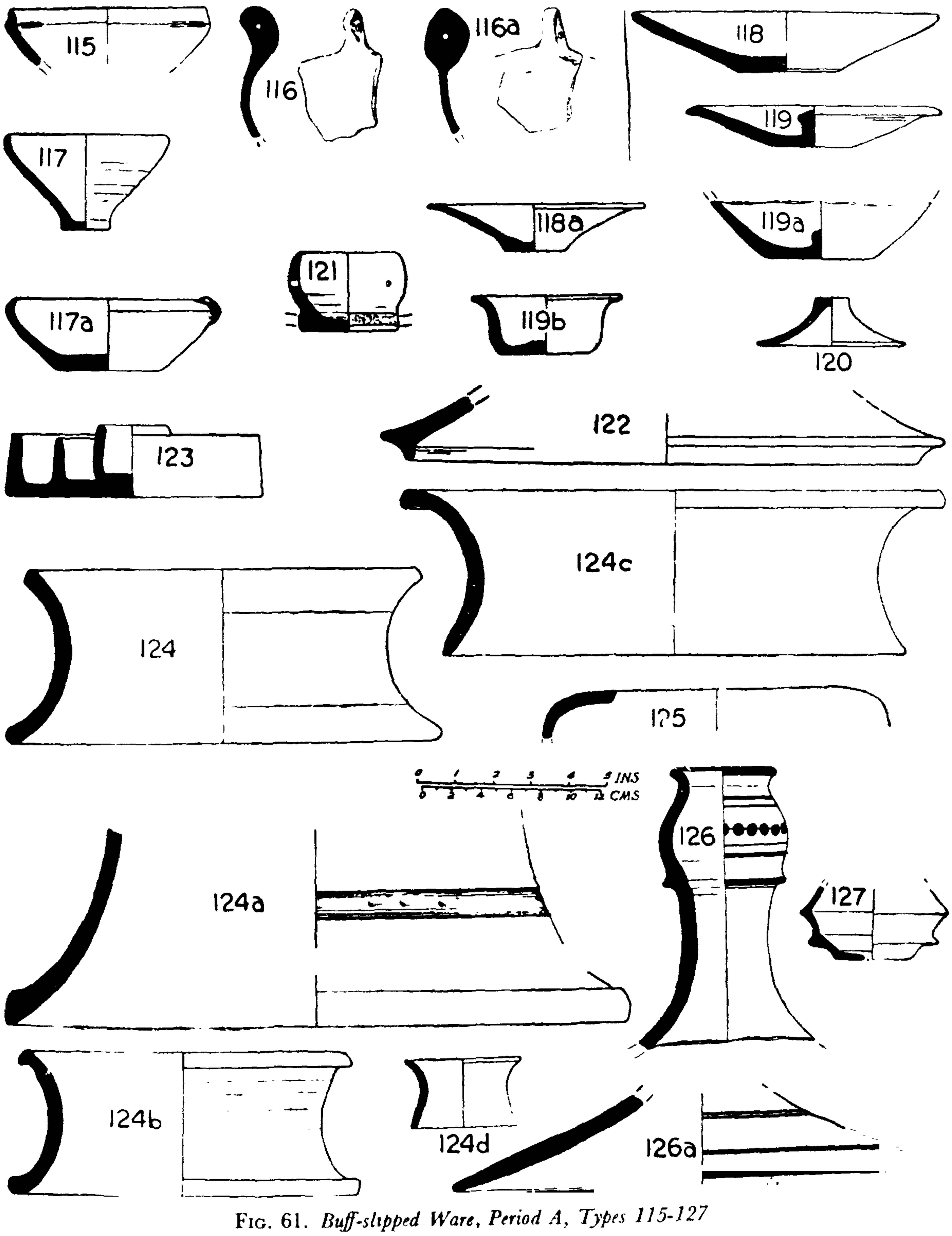

FIG. 61. *Buff-slipped Ware, Period A, Types 115-127*

Type 126. Water-jug with a long neck as in a *surāhi*. 'S'-profile above the flange and concave below. Painted in violet over buff withrow of balls over a horizontal band and enclosed between bands. From late level. *Variant 126a,* representing the base of a *Surāhi* shaped vessel. Painted in black over red on the exterior with horizontal band.

Type 127. Small pot of thin fabric with an externally-corrugated convex profile and flat base. From late level.

(iii) *Buff Ware*

The body material of the Buff Ware contains a small quantity of lime and the fabric is slightly coarse when compared with that of the Red Ware and the Buff-slipped Ware. The vessels are sturdy and well-fired and emit a metallic sound when struck. The section is generally greenish-buff in colour but in some cases a thick yellowish inner zone and a thin greyish-buff outer zone can be seen. The vessel surface was given a buff wash before firing. Painting was executed in light black or chocolate by using ferro-manganese ore for the pigment. According to the Archaeological Chemist the lime contents of the body material did not develop although the vessel was fired under oxidising conditions, which resulted in the buff colour of the fabric. The Red Ware is invariably associated with the Buff Ware at the Harappan sites in Gujarat, and the shapes common to both, are the S-shaped vessel, convex-sided storage-jar, convex-sided bowl, small globular jar, dish-on-stand, dish, cylindrical perforated jar, basin and trough. The Buff Ware is conspicuous by its absence in the Indus and Ghaggar Valleys. The reason is not far to seek. The proportion of *kankar* nodules in the alluvial clay deposited by the rivers in Gujarat which through the metamorphosed limestone beds is fairly high when compared with the extremely low contents in the alluvial beds of the Indus. It is necessary to note here that the Buff Ware of Gujarat bears little resemblance to the Buff Ware of the Amri-Nal group which is thinner in fabric and less sturdy. The surface is rather creamy in colour.

Fig. 62

Type 128. Large storage-jar of thick fabric with a thick projected rim, narrow mouth, ledged shoulder and bulbous body. Yellowish brown slip on the exterior flaked off. Drops of red paint on the interior visible. From late level.

Type 129. Storage-jar of thick fabric with a beaded rim, narrow mouth globular body and narrow flat base. Light chocolate slip applied over a buff background in the upper and middle protions. Painted in chocolate horizontal bands on the exterior. From late level. *Variant 129a,* with a ribbed shoulder. Dark-red slip applied over a buff background. Painted with a pellet design on the shoulder. From late level. *Variant 129b,* with a short projected rim and and narrow neck. Painted in chocolate with hatched leaf-patterns and horizontal bands above. From late level.

Type 130. Large storage-jar of thick fabric with a projected rim, wide mouth ledged shoulder and convex profile. From middle level. *Variant 130a,* with thin walls. Painted with chocolate horizontal bands on the shoulder. From middle level.

Type 131. Large storage-jar of thick fabric with a wide mouth, clubbed rim and almost straight sides. Greenish chocolate slip applied on the exterior. From late level.

Fig. 63

Type 132. Storage-jar of medium fabric with a flanged rim. From late level. This is the upper part of a 'S'-shaped vessel. *Variant 132a,* with two holes below the rim for suspension or fastening lid. From early level.

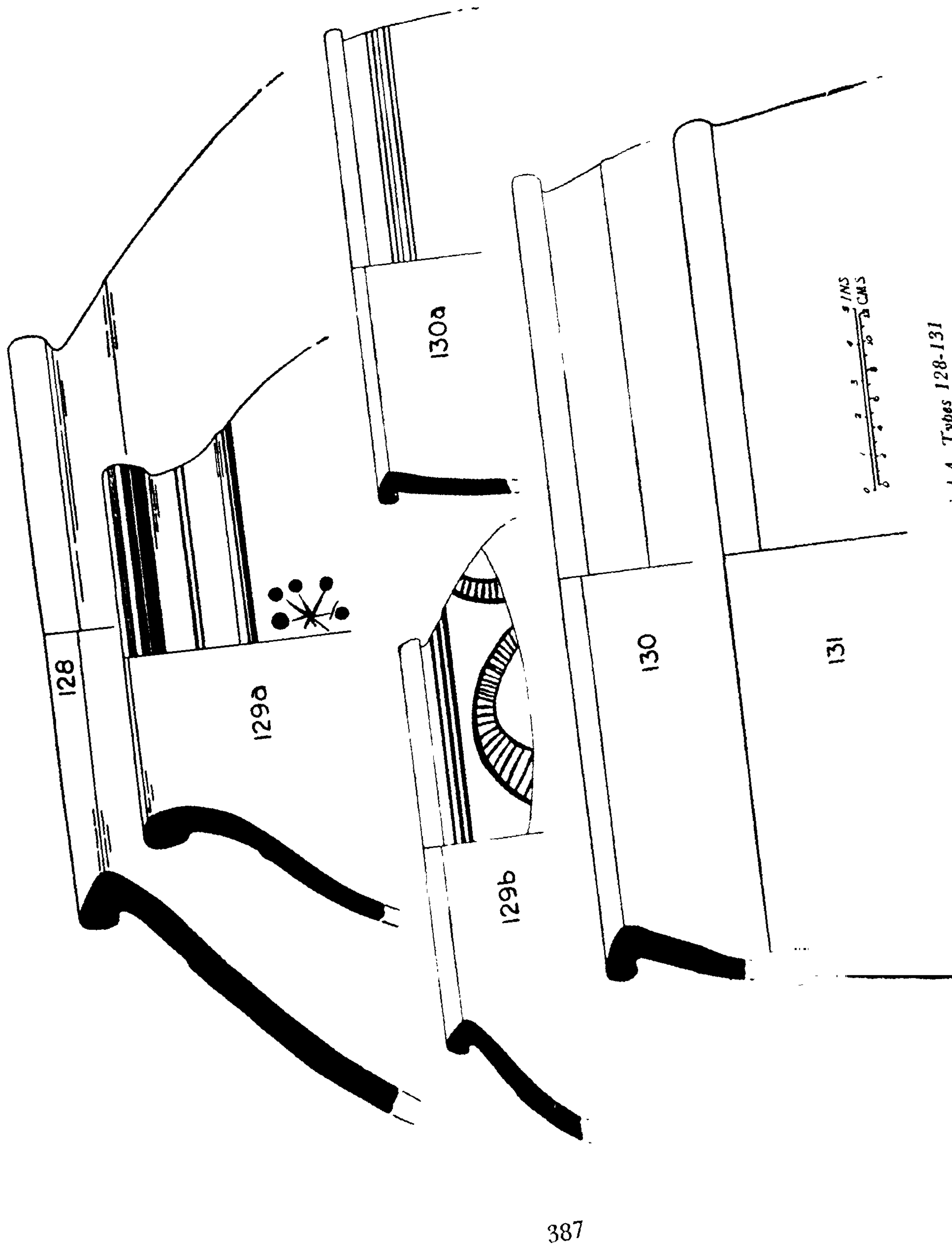

Fig. 62. *Buff Ware, Period A, Types 128-131*

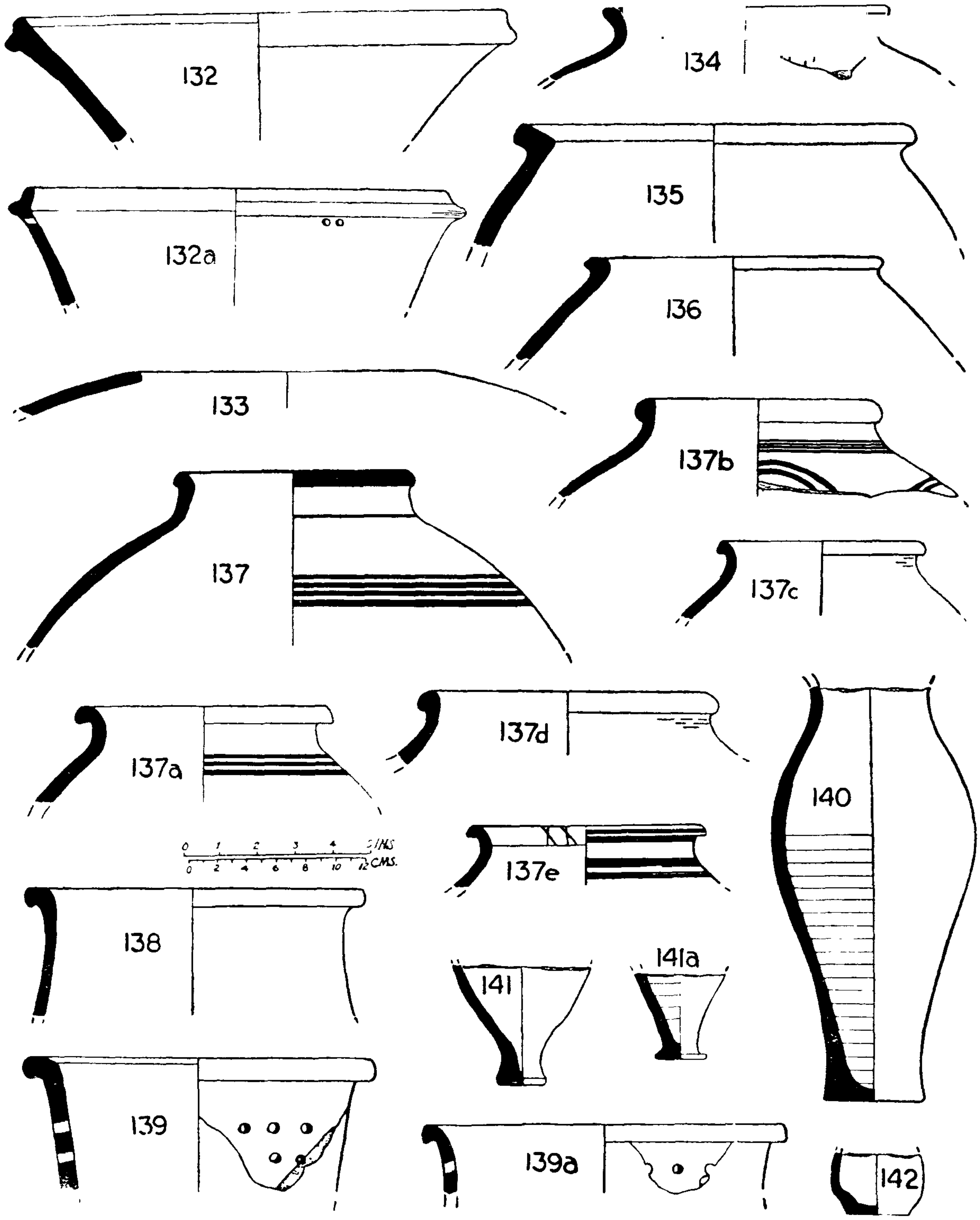

FIG. 63. *Buff Ware, Period A, Types 132-142*

Type 133. Jar of medium fabric with a bulbous body. No neck. From late level.

Type 134. Jar of medium fabric, with a flaring rim and bulbous body. Painted in chocolate over a buff slip with a horizontal band on the rim and neck. Also oblique strokes below. From late level.

Type 135. Jar of thick fabric with a flaring projected rim and convex profile. Chocolate slip applied on the exterior. From late level.

Type 136. Jar of medium fabric with a beaked rim and bulbous body. From middle level.

Type 137. Jar of medium fabric with a beaked rim, raised neck and globular body. Painted in black over light brown with horizontal bands on the rim and belly. From late level. *Variant 137a,* with a prominent beaked rim. Painted with chocolate bands on the shoulder. From middle level. *Variant 137b,* with a beaded rim. Painted with chocolate horizontal bands on the neck and double arcs below. From middle level. *Variant 137c,* with a projected obliquely cut rim and thin walls. From early level. *Variant 137d,* with a beaded rim and low neck. From late level. *Variant 137e,* with a projected rim. Graffiti marks on the rim visible. From late level.

Type 138. Jar of medium fabric with a beaded rim and slightly concave neck. Painted in pink over buff with horizontal bands. From middle level.

Type 139. Cylindrical perforated jar with a flat projected rim and straight sides. Painted in red over buff with horizontal bands. From middle level. *Variant 139a,* with a beaked rim. From late level.

Type 140. Vase of thin fabric with a footed base. From middle level.

Type 141. Goblet of thin fabric with a bulbous body and narrow footed base. Chocolate slip applied on the exterior. From surface. *Variant 141a,* with a projected base. Greenish slip applied. From late level.

Type 142. Beaker of thin fabric with a flat base. From late level.

Fig. 64

Type 143. Large stem of dish-on-stand of medium fabric with a broad beaded base and grooved interior. From late level. *Variant 143a,* of small size with a projected base. Painted in pink over buff with horizontal bands From surface *Variant 143b,* of thin fabric and small size with a beaded base Painted with horizontal bands in dark chocolate over a light chocolate slip applied on a buff wash. From surface.

Type 144. Squattish stem of medium fabric with a beaded base. From surface.

Type 145. Dish of a dish-on-stand, medium fabric with an excurved obliquely-cut rim, chocolate slip on the interior and a buff slip on the exterior. Painted with chocolate concentric bands on the interior and horizontal bands on the exterior. From late level.

Type 146. Dish of thin fabric with a projected rim, carinated shoulder and flat base. Painted in chocolate over greenish-buff with suspended loops on the rim and concentric bands on the interior. From late level.

Type 147. Dish of thin fabric with a nail-headed rim and incurved sides. From middle level. *Variant 147a,* of medium fabric with an incurved rim and flat base. From late level.

Type 148. Large dish of thick fabric with an obliquely-cut projected rim. Painted with chocolate bands and suspended loops. From late level. *Variant 148a,* with a prominent projected rim. From middle level. *Variant 148b,* with a nail-headed rim. Painted with chocolate concentric bands on the interior and horizontal bands on the exterior over a light chocolate slip. From late level.

Type 149. Dish or dough plate of medium fabric with an obliquely-cut rim and flat base. Hand made. From late level.

Type 150. Basin of medium fabric with a flaring projected rim and blunt carinated shoulder. Incised cord design visible on the exterior. From middle level. *Variant 150a,* with a nail-headed rim and deep tapering sides. Painted in pink over buff with horizontal bands.

Type 151. Small basin of medium fabric with a flaring rim and blunt carinated shoulder. From late level. *Variant 151a,* with a projected rim and straight sides. From surface. *Variant 151b,* with a short out-turned rim. From late level. *Variant 151c,*

Type 152. Bowl of thin fabric with an everted rim, concave profile and blunt carinated shoulder. Thick chocolate slip applied on the interior and light chocolate on the exterior. From late level.

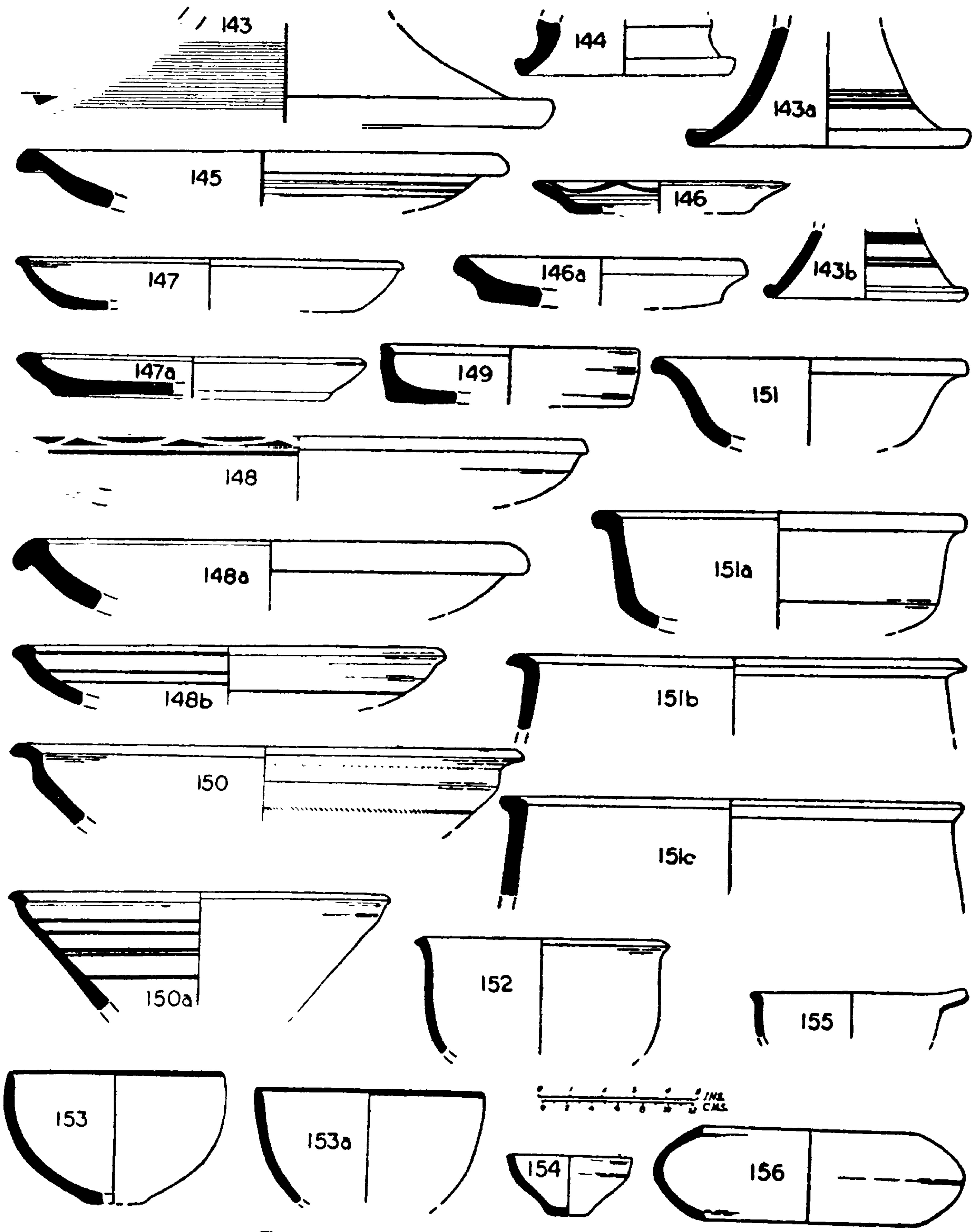

FIG. 64. *Buff Ware, Period A, Types 143 to 156*

Type 153. Bowl of thin fabric with a featureless rim, convex sides and flat base. Painted with chocolate over buff with horizontal bands on the rim. From late level. *Variant 153a,* with a thin chocolate slip applied on the exterior and dark chocolate on the interior. Unstratified.

Type 154. Miniature bowl of thin fabric with a flat base. From late level.

Type 155. Bowl of thin fabric with a flat projected perforated rim. Unstratified.

Type 156. Ring stand of thin fabric with incurved ends and convex profile. From late level.

(iv) *Green Ware.*

Vessels with a greenish section occur in limited numbers along with the Red Ware vessels in Gujarat as well as the Indus Valley. Occasionally, a chocolate slip or wash is given over greenish slip, and the painting is also executed in chocolate. The fabric is sturdy and of medium thickness. The main types in this ware are the globular jar with a small neck, dish and convex-sided bowl. The green colour is due to over-firing in some cases.

Fig. 65

Type 157. Large storage-jar of thick fabric with a flat projected rim. From late level. *Variant 157a,* of medium fabric with a convex profile. Painted in chocolate over green slip with loops at the rim. From middle level.

Type 158. Storage-jar of medium fabric with a clubbed rim. From late level.

Type 159. Storage-jar of medium fabric with a flanged rim. Light chocolate slip applied on the exterior. Painted with dark chocolate horizontal bands at the rim and a looplike stroke below. From middle level.

Type 160. Jar of medium fabric with a beaded rim, raised neck and globular body. Thin chocolate slip applied over a greenish surface. From late level.

Type 161. Small jar of thin fabric with a featureless rim, raised neck and globular body. From medium level.

Type 162. Vase of medium fabric with a flat base. From late level.

Type 163. Stem of dish-on-stand of thin fabric with a beaded base. From late level.

Type 164. Stem of dish-on-stand of thin fabric with a flanged base. Painted in chocolate over chocolate slip with horizontal bands on the exterior. From late level.

Type 165. Large dish-on-stand of medium fabric with a splayed-out rim and carinated shoulder. Painted in chocolate over greenish slip with concentric bands enclosing a beaded band on the interior. From surface.

Type 166. Dish of medium fabric with a splayed-out rim and carinated shoulder. Chocolate slip applied on both surfaces. From surface.

Type 167. Dish of medium fabric with an incurved rim and thick flat base. From surface. *Variant 167a,* of thin fabric with a nail-headed rim. From late level. *Variant 167b,* with a thick projected rim. Painted in dark chocolate over a light chocolate slip with a horizontal band and loops. From surface. *Variant 167c,* with an expanded rim. From late level. *Variant 167d,* with a nail-headed rim. From late level. *Variant 167e,* with a clubbed rim. From surface.

Type 168. Trough of medium fabric with an incurved raised rim and flat base. From late level.

Type 169. Basin of thin fabric with a beaked rim. Greenish on account of over-firing. From late level.

Type 170. Cup of thin fabric with an incurved rim and flat perforated handle. Hand made. From middle level.

Type 171. Lid of thin fabric with tapering sides and flat base. From surface.

(v) *Grey Ware.*

A grey ware of fine fabric occurs in a very small quantity both at Rangpur and Lothal. It is noticed in Harappa, Mohenjo-daro and Kalibangan also. Its grey colour which occa-

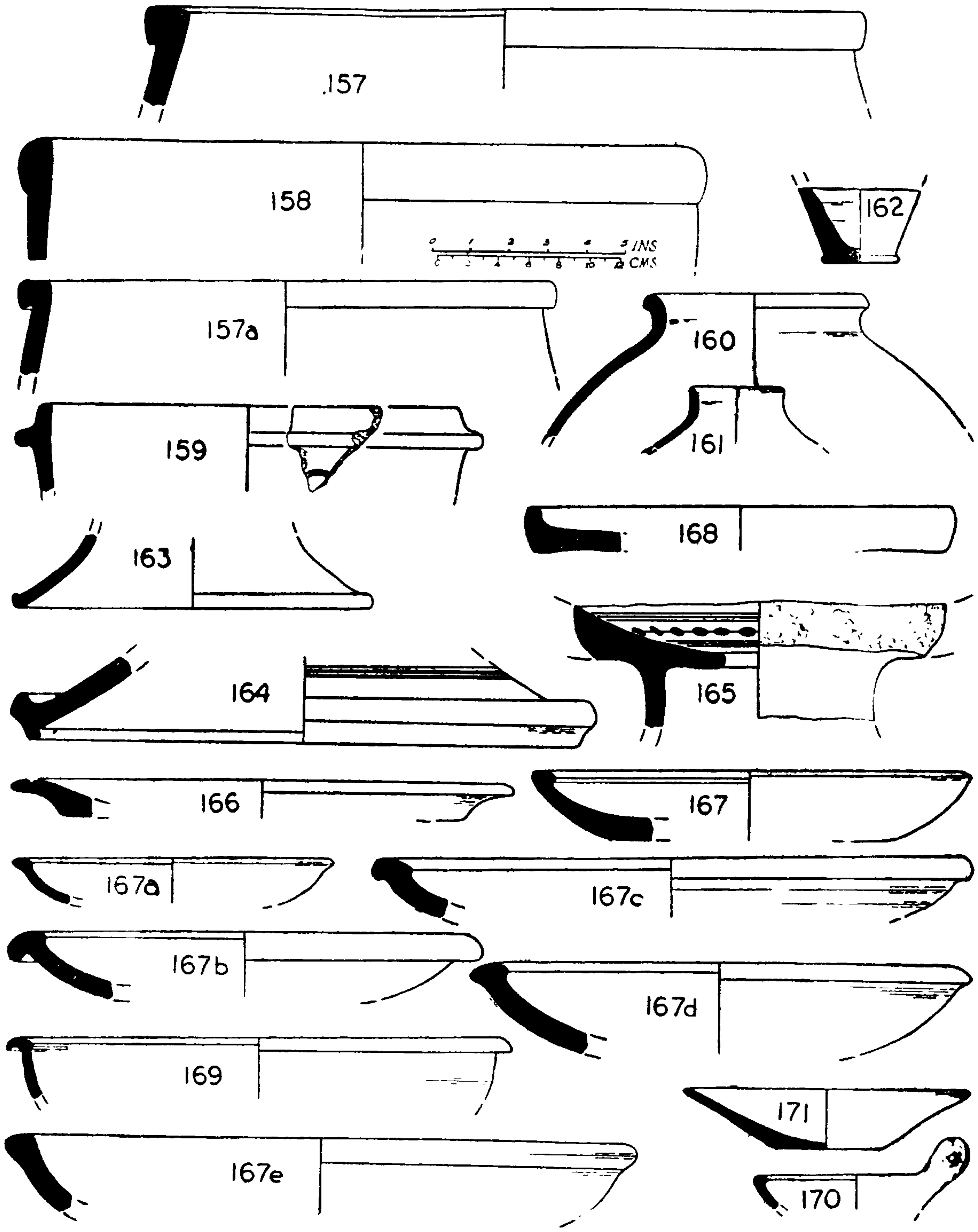

FIG. 65. *Green Ware, Period A, Types 157 to 171*

sionally deepens into black is attributed to the use of carbonaceous matter. It may also be due to firing under reducing conditions. The texture of the vessels is homogenous and the surface is well burnished. The only types found in this ware are the dish and small globular jar, gobbet, bowl, dish-on-stand and lid A coarser variety of grey ware with a gritty fabric found in considerable quantity is referred to under Associated wares.

Fig. 66

Type 172. Large storage-jar of thick fabric with a splayed rim, ledged neck and bulbous body. From late level. *Variant 172a,* with a thin beaked rim. From late level.

Type 173. Small jar of thin fabric with a flaring mouth and globular body. From late level. Pl. CLXIX D, *1. Variant 173a,* with a disc base and burnished surface. From late level. Pl. CLXIX D, *2. Variant 173b,* with a short everted rim and wide mouth. From middle level.

Type 174. Goblet of thin fabric with a ledged shoulder and pointed base. Painted with pared designs on the exterior. From late level. Pl. CLXIXD, *3. Variant 174a,* with an everted rim and raised neck. From late level. *Variant 174h,* with a thick and broad base. From surface.

Type 175. Broad stem of dish-on-stand of medium fabric with a beaded base. Burnished. From middle level.

Type 176. Dish of medium fabric with a splayed-out rim and carinated shoulder. From late level.

Type 177. Bowl of thin fabric with a featureless rim and bulbous body. From middle level. *Variant 177a,* with a slightly everted rim. From late level.

Type 178. Bowl of thin fabric with a stud-handle and bulbous body. From late level.

Type 179. Lid of thin fabric with a flanged base and internally hollow knob. From late level. *Variant 179a,* with an externally hollow knob. From late level. Pl. CLXIX D, *4.*

C. Associated wares

(i) *Micaceous Red Ware*

This indigenous red ware known for its distinctive shapes and shining micaceous red surface appears to have been in use at Lothal even before the Harappans arrived on the scene. It has a long life and is coeval with the Harappa wares. Its texture is fine and uniformly burnt. The surface is very smooth and the vessels are generally thin i.e., less than 25 ins. in thickness. A slip light red to orange in colour was applied on surface and burnished. In shape, surface treatment and painting the Micaceous Red Ware differs greatly from the characteristic Harappa wares. The globular jar with a flared mouth, the convex-sided bowl with a featureless rim, lamp with pinched lip, perforated cylindrical jar and the bowl with a stud-handle are the only types found in this ware. The painting executed in black over red or orange is confined to the rim and handle in the case of bowls and to the upper half of the vessel in the case of jars. A few bowls are painted on the interior also. The designs consist of horizontal bands and wavy lines, loops and zig-zag lines, cross-hatched diamonds and groups of dots and strokes. There are only three bowls in the Micaceous Red Ware on which painting is done in white as in the case of the black-and-red ware. The only conclusion that can be drawn from the close identity in the shape and composition of the Micaceous Red and black-and-red ware vessels in Kathiawar and the conspicuous absence of both the wares in the Indus Valley is that they are indigenous. Although it was not possible to reach a purely pre-Harappan level where the black-and-red ware and the Micaceous Red Ware were exclusively used, the probability of reaching this level inspite of the difficulties presented by the sub-soil water is very high, for, at a depth of 10 ft. below water level in SRG 30, the Harappan wares were almost insignificant when compared with

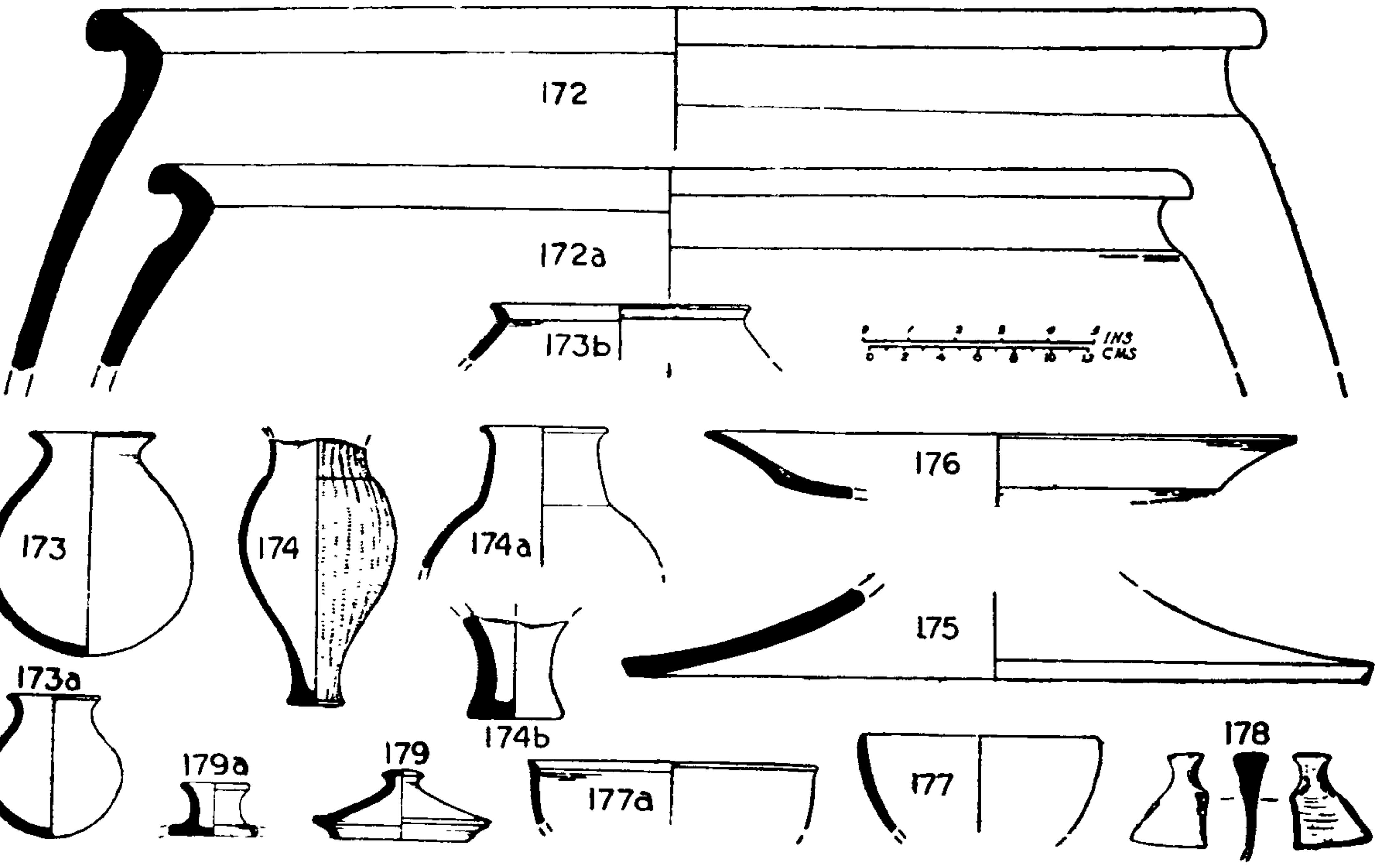

FIG. 66. *Grey Ware, Period A, Types 172 to 179*

the Micaceous Red Ware in bulk. That these indigenous ceramic traditions were too strong to be ignored by the Harappans is evident from the fact that the local wares continued to be widely used by them throughout Period A and some indigenous types were even copied in Harappans fabric.

Mention must be made here of the close resemblance between 'jars with out turned rim' from the pre Harappan levels of Kalibangan and the Micaceous Red Ware jars in the flaring rim and rounded base some of which are painted with thick black bands and oblique lines (types 189 g, and 269).

Fig. 67

Type 180: Large jar of medium fabric with an everted rim, wide mouth, ribbed neck and bulbous body. Painted in black over a pale-brown slip with horizontal bands enclosing wavy bands on the shoulder. From late level. *Variant 180a,* squattish. Painted in black over light-orange with horizontal bands enclosing panels of loops. From middle level. *Variant 180b,* with a flaring rim and bulbous body. Painted with wavy bands below a horizontal band on the shoulder. From late level. *Variant 180c,* painted with thin brush in black horizontal lines enclosing loops on the exterior and on the rim. From late level.

Fig. 68

Type 181: Jar of thick fabric with a flaring rim narrow mouth and bulbous body. Painted in black over orange with a horizontal band and a wavy line below on the shoulder and a band on the rim. From middle level. *Variant 181a,* of medium fabric. Painted in black over light-red with thin wavy lines and loops between horizontal bands on the shoulder. From late level. *Variant 181b* painted in black over light red with loops on the rim and oblique strokes between horizontal bands on the shoulder. From late level. *Variant 181c,* painted in black over an orange slip with horizontal bands enclosing loops and wavy lines. From early level. *Variant 181d,* painted with cross-hatched horizontal panels enclosing blank circles and a horizontal band below. From middle level. *Variant 181e,* painted in black over a light-red slip with loops below a horizontal band on the rim and horizontal bands enclosing wavy lines and loops. From late level. *Variant 181f,* painted with horizontal bands enclosing two panels of wavy lines on the exterior. From late level. *Variant 181g,* with a sharp-edged rim. Black painting on the rim and horizontal bands enclosing a cross-hatched loop below. From early level Compare types 2, 4, 7, from Kalibangan.[1] *Variant 181h,* with a sharp-edged rim, flaring mouth and bulbous body. From late level. Pl. CLXX A, *1. Variant 181i,* painted with horizontal bands enclosing concentric loops on the rim and vertical wavy lines and dots below horizontal bands. From late level. *Variant 181j,* with an ovoid body. From late level. Pl. CLXX A, *2. Variant 181k,* painted in black over red with horizontal bands at the neck and vertical rows of strokes on the rim and body. From early level. *Variant 181l,* painted with horizontal bands on the exterior. From late level. *Variant 181m,* with a thick blunt rim. From late level. *Variant 181n,* with a short everted rim and globular body. From late level. *Variant 181o,* with a wide mouth and bulbous body. From late level.

Type 182. Jar of thin fabric with a constricted neck and globular body. Painted in black over light-red with horizontal bands. From late level. *Variant 182a,* with a flat base. From late level.

Type 183. Jar of thin fabric with a flaring rim and flat base. Painted in black over orange with oblique strokes below a horizontal band on the interior and horizontal bands on the shoulder. From late level.

Type 184. Cylindrical perforated jar of medium fabric with a flaring rim. Painted in black over light-red with loops below a horizontal band on the rim and three horizontal bands below. From late level.

Type 185. Bowl of medium fabric with a flaring rim, convex sides and round base. Painted in black over orange with horizontal bands and loops on the rim, vertical lines on the interior and horizontal bands on the shoulder. From late level. *Variant 185a,* with an everted rim. From late level.

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[1]*Indian Archaeology,* 1961-62, fig. 15, *2, 4,* and *7.*
[2]*Indian Archaeology,* 1961-62, fig. 15.

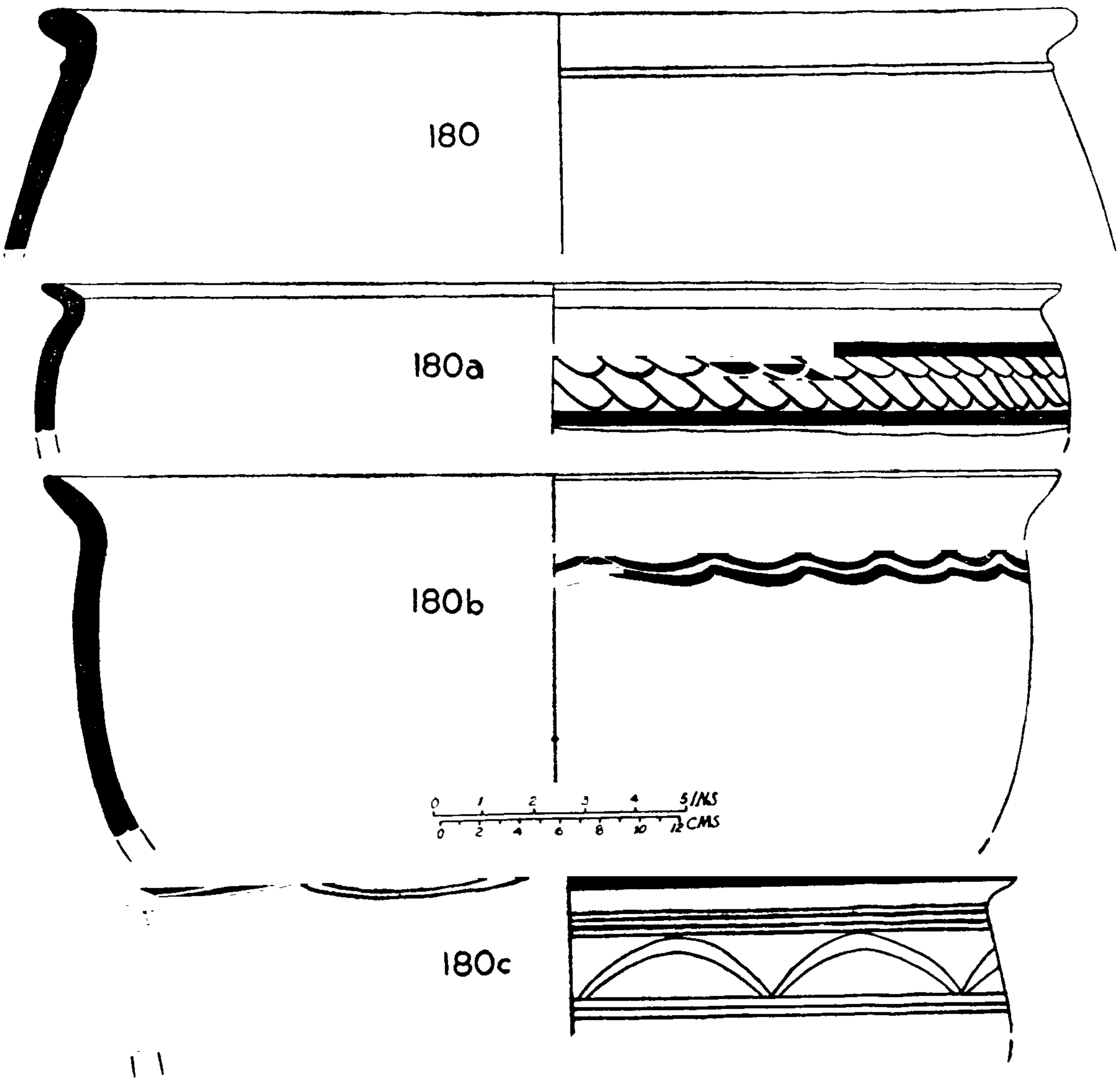

FIG. 67. *Micaceous Red Ware, Period A, Types 180-180c*

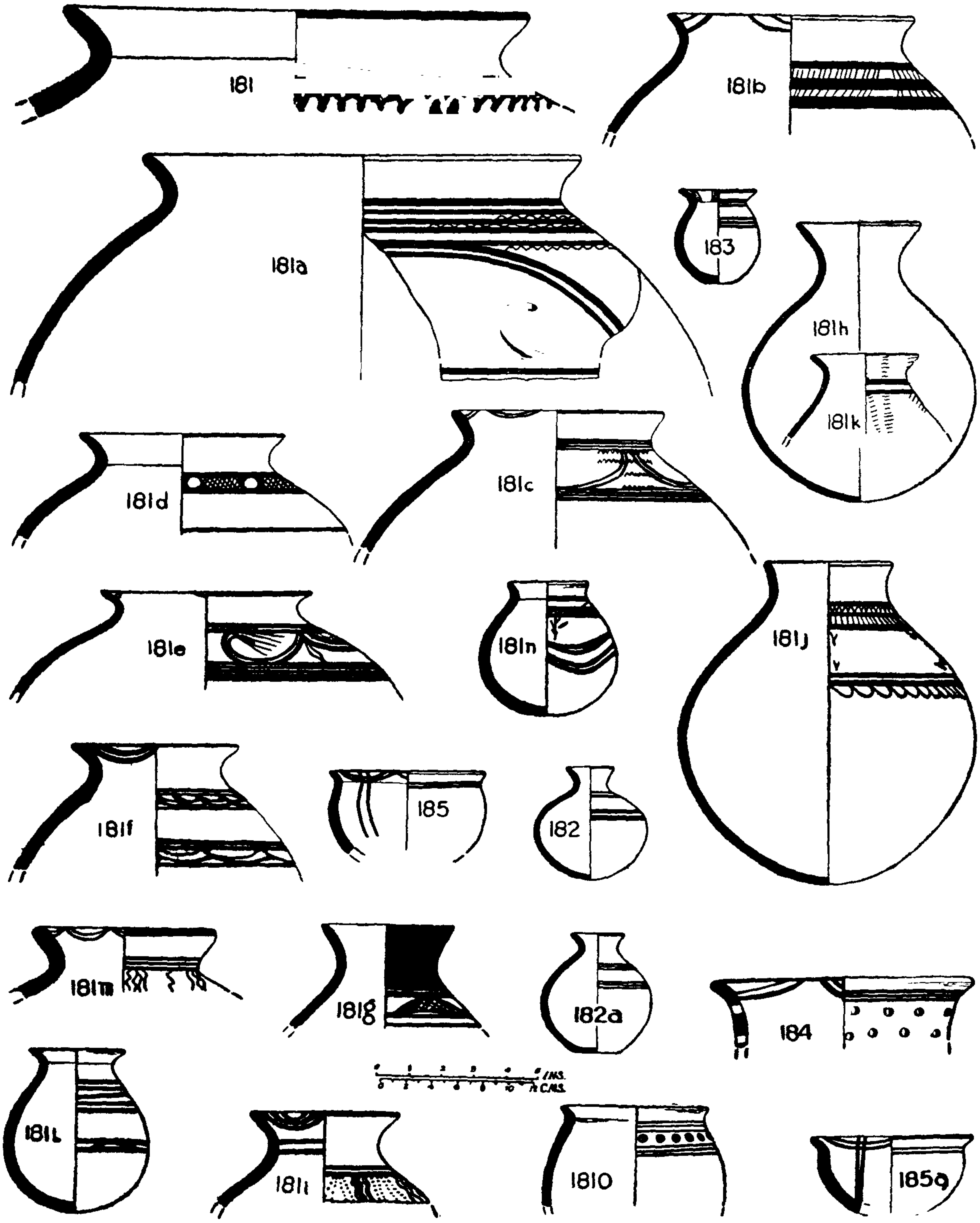

FIG. 68. *Micaceous Red Ware, Period A, Types 181-185a*

Fig. 69

Type 186. Bowl of medium fabric with a flaring rim and carinated shoulder. Painted in black over light red with loops on the rim which are partially visible. From late level. *Variant 186a,* with a short everted rim. Painted in black over orange with horizontal bands and loop on the rim and a vertical line on the interior. Horizontal bands noticed on the exterior also. From late level. *Variant 186b,* with a rough surface. Painted in black over orange with an arc-like design on the interior. From late level.

Type 187. Bowl of medium fabric with a featureless rim, convex sides and round base. Painted in black over light-red with hatched diamonds in a vertical row on the interior and horizontal bands on the exterior. From middle level. *Variant 187a,* with an incurved rim. Painted in black over orange with horizontal bands on the exterior. From early level. *Variant 187b,* with a featureless rim and slightly carinated below. Painted in black over light red with vertical strokes in groups below horizontal bands on the exterior. From late level. *Variant 187c,* with a featureless rim and carinated shoulder. From late level.

Type 188. Bowl of thin fabric with a featureless rim, convex sides, round bottom and vertical stud handle. Painted in black over orange-red with horizontal bands and hatched diamonds on the interior and a hatched circle on the handle. From early level. *Variant 188a,* painted with a vertical hatched ladder-design on the interior, oblique strokes on the exterior below the handle and hatched circle on top of it. From middle level.

Type 189. Lamp of medium fabric with an obliquely-cut rim, a pinched lip for the wick and a sagger base. Painted in black over red on the exterior with horizontal bands and intersecting lines on the interior. From middle level. *Variant 189a,* with a flattish rim. From late level.

(ii) *Coarse red ware*

Along with the Red, Buff and Micaceous Red Wares, all of which were of superior fabric some coarse wares of gritty fabric were also in use at Lothal. In the latter case the clay used is not levigated and degraissants in the form of sand, lime, chaff and cow-dung were added. The use of carbonaceous matter and imperfect firing were responsible for the smoky core of the vessels. The coarse wares occur mostly in Gujarat and a few however occur occasionally in Ahar and Navdatoli.

The coarse red ware with a gritty fabric and smoky core was in use throughout the occupation of Lothal and is found to be more popular in the late levels of Period A and throughout Period B. The thin top layer of the upper surface of the vessels is dull red in colour and the pots are generally unslipped. The surface of some of the vessels is finished with a liquid clay and a few others are given a dull red wash. Painting is resorted to in very few cases by drawing horizontal and wavy lines, oblique strokes and dots in black over a red slip (fig. 70, *191, 191a* and fig. 71, *201a* and *201b*). Incised designs are finger and nail-tip marks, notches, cord impressions and grooved wavy lines. Rarely stamping is resorted to. The external surface is mildly corrugated in a few cases. The progressive increase in the use of the coarse red ware and coarse grey in Phases, III, IV and V and the decrease in the quantity of superior wares in phases IV and V suggest that people could not afford to have many finer wares.

The main types in the coarse wares are the bulbous jar with a flaring rim and rounded bottom, the bowl with rounded bottom and flaring rim, the thick round bottomed bowl used by the copper-smiths for melting ingots of copper. The convex-sided bowl in the coarse red ware is reminiscent of the bowl in the Micaceous Red Ware and the black-and-red ware. The round-bottomed jar with a flaring rim is another type common to all the Associated wares. Occasionally the potter tried to improve the look of the coarser wares by the application of a thick red slip over which simple designs were painted in black. Perhaps the Micaceous Red Ware, the black-and-red ware and the coarse red and grey wares together

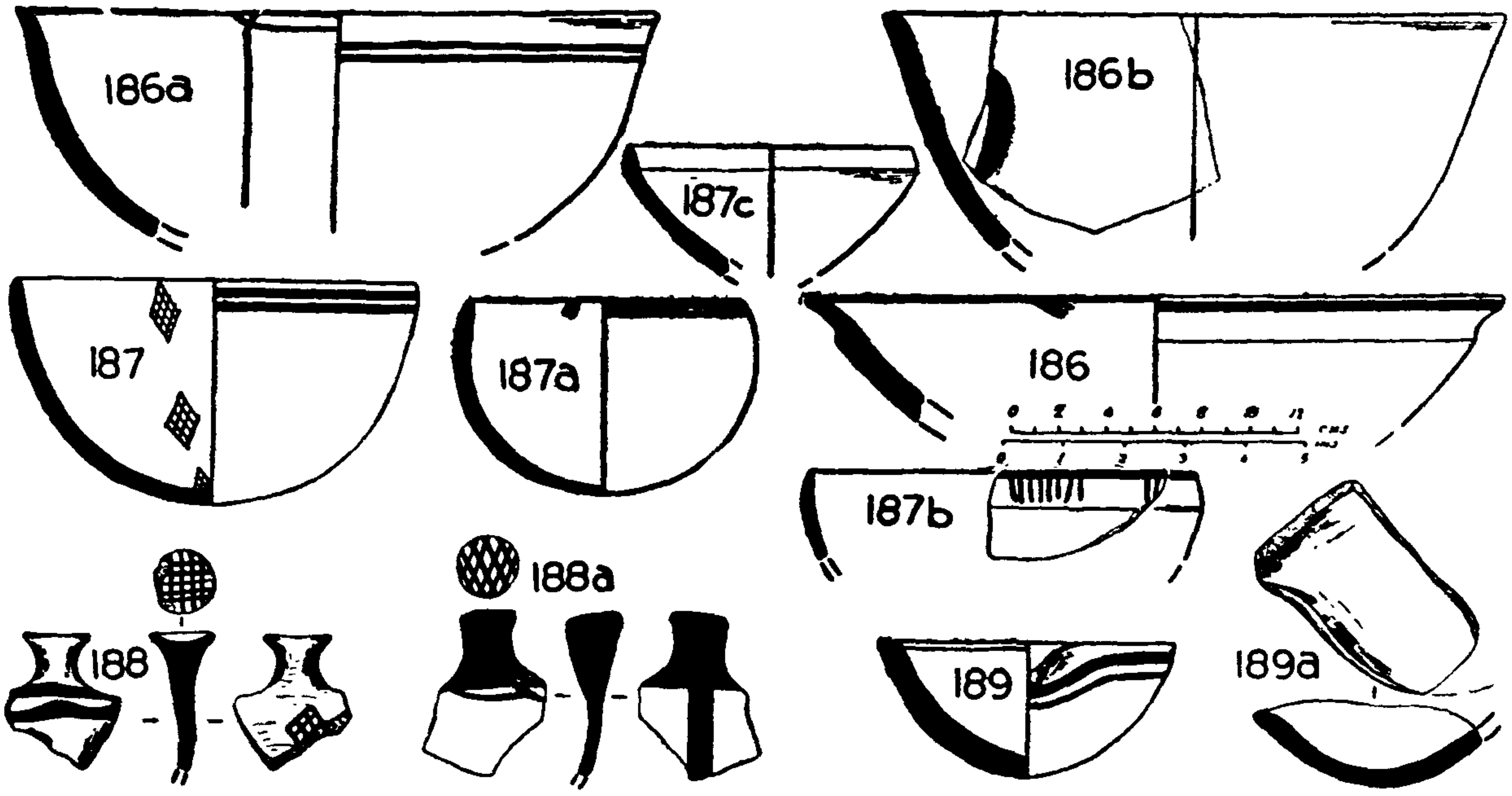

FIG. 69. *Micaceous Red Ware, Period A, Types 186-189a*

formed the ceramic equipment of an indigenous population in the Harappan and pre-Harappan times in Kathiawar. Towards the end of Period A at Lothal some jars developed a comparatively short neck and splayed rim with an acute angle turn on the interior of the neck.

Fig. 70

Type 190. Jar of medium fabric with a flaring rim and bulbous body. Gritty fabric, smoky core and dull-red matt surface. From early level. *Variant 190a,* with a splayed rim. Incised vertical slashes at intervals on the shoulder. From middle level. *Variant 190b,* with a short everted rim and globular body. From late level. *Variant 190c,* with an everted rim. Superior fabric. Incised herring bone pattern on the soulder. From late level. *Variant 190d,* with a flaring rim and globular body. Incised horizontal lines on the shoulder. From surface. *Variant 190e,* painted with a notched loop-design on the exterior. From surface.

Type 191. Jar of medium fabric with a reddish core. Painted in black over red matt surface with oblique strokes below a horizontal band on the interior, three pronged design on the rim and oblique strokes between horizontal bands on the shoulder. From middle level. *Variant 191a,* with a globular body. Painted with black horizontal bands enclosing oblique strokes on the exterior. From surface.

Type 192. Jar of medium fabric with a flaring rim, ledged neck and globular body. Oblique slashes on the exterior. From late level. *Variant 192a,* with ribbed shoulder. From late level. *Variant 192b,* with two ribs on the shoulder. Red slip applied on the exterior. From late level.

Type 193. Jar of medium fabric with a flaring rim and globular body. Scored on the shoulder. From middle level.

Type 194. Squattish jar of medium fabric with a beaded rim, and ribbed shoulder. Oblique slashes on the shoulder noticed. From late level.

Type 195. Squattish jar of medium fabric with a short flaring rim, ribbed shoulder and sagger base. Knife marks left while removing excess of clay from bottom visible. Red wash applied on the shoulder. From late level.

Type 196. Small jar of medium fabric with an everted rim and wide mouth. From late level. *Variant 196a,* with a slightly bulbous body. From late level.

Type 197. Perforated jar of thin fabric with a flaring rim. Pale-brown slip applied on the exterior. From late level.

Fig. 71

Type 198. Goblet with a thick solid stem of superior fabric. Hand made. From late level. *Variant 198a,* with a slightly concave base. From late level. *Variant 198b,* with a hollow pedestal base. From late level. *Variant 198c,* with a partially hollow stem. From late level.

Type 199. Hand-made dish or dough plate? with a straight rim and flat base. From middle level. *Variant 199a,* with slightly concave upper surface and no rim. From late level. *Variant 199b,* with a short everted rim with finger-tip designs and concave base. From late level. *Variant 199c,* with a flaring rim. From late level.

Type 200. Basin of medium fabric with a projected rim and convex sides. Red slip applied on both surfaces. From late levels.

Type 201. Bowl of thin fabric with a featureless rim and convex sides. Painted in black over red with loops below horizontal bands on the exterior. From middle level. *Variant 201a,* painted in black over pinkish-red with a loop below a horizontal band on the exterior and four oblique strokes and dotted design on the interior. From late level. *Variant 201b,* with an incurved rim. Painted in black over pale brown with oblique strokes on the exterior. From late level.

Type 202. Bowl of thick fabric with an everted rim, grooved exterior and convex profile. From late level. *Variant 202a,* with an under-cut everted rim and grooved exterior. From late level.

Type 203 Bowl of thick fabric with a round bottom. Hand made. Buff wash applied. From late level *Variant 203a,* with a sagger base. From late level.

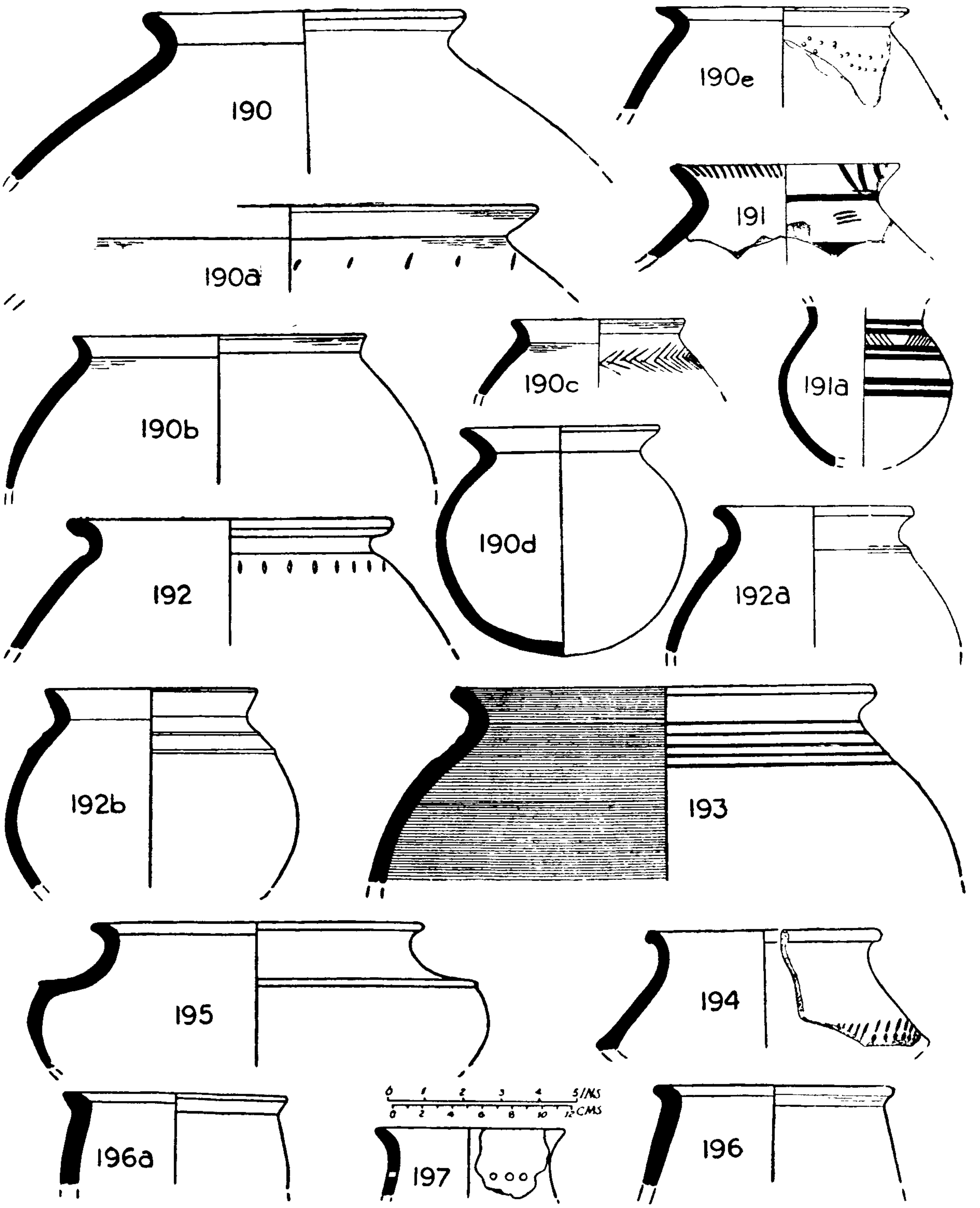

FIG. 70. *Coarse red ware, Period A, Types 190-197*

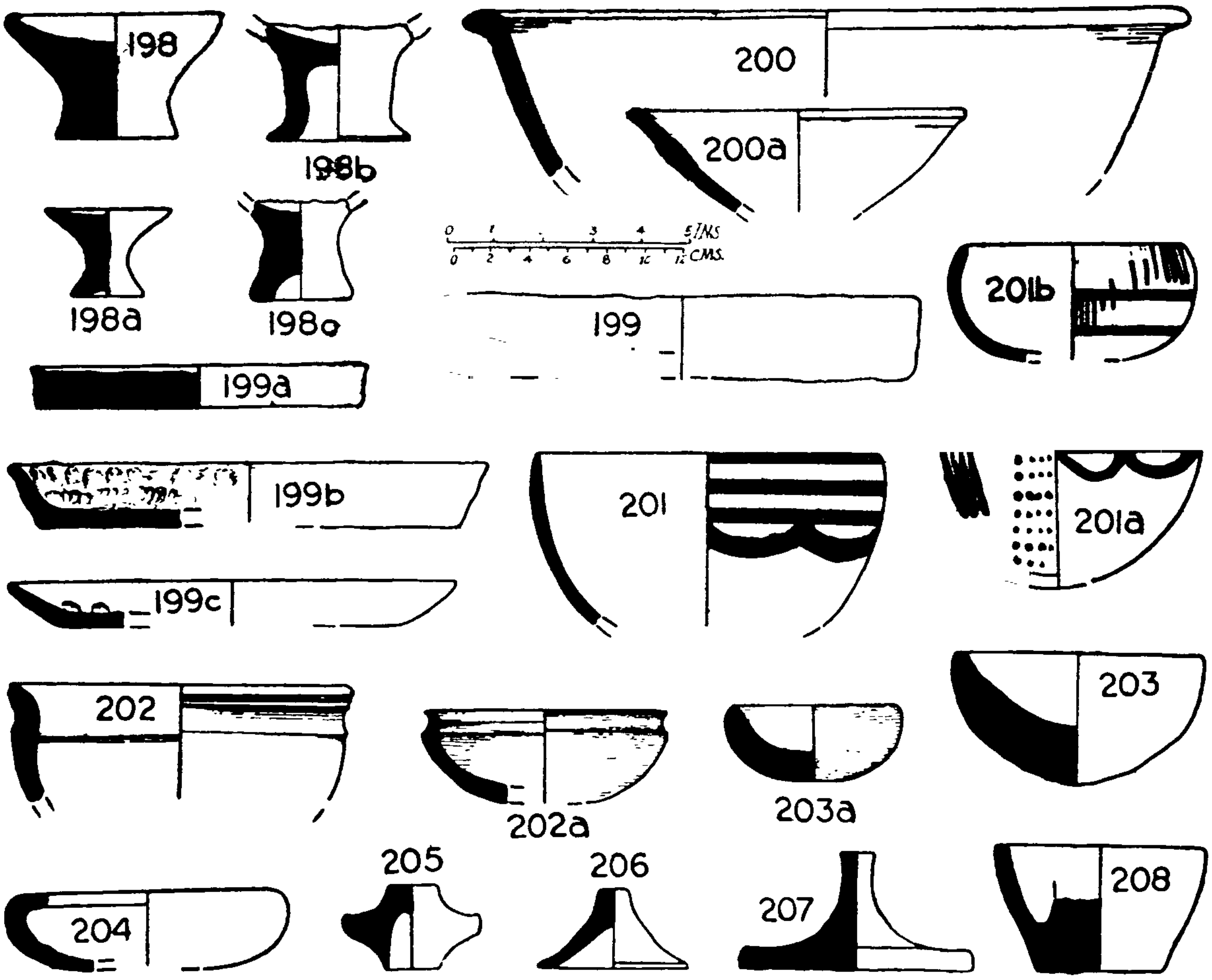

FIG. 71. *Coarse red ware, Period A, Types 198 to 208*

Type 204. Lamp of medium fabric with an incurved rim and sagger base. From late level.

Type 205. Lid of medium fabric with a flanged base and internally hollow knob. Hand made. From late level.

Type 206. Small lid with an internally hollow knob. Hand made. From late level.

Type 207. Lid of thick fabric with a long knob and flat base. Hand made. From late level.

Type 208. Lid of thick fabric with tapering sides, flat base and internal knob. Hand made. From surface.

(iii) *Coarse grey ware*

This ware is only next to the coarse red ware in frequency, occurring as it does in all the phases in progressively increasing quantities. As stated earlier (above p. 398) its grey colour is partly due to differential firing and partly to carbonaceous matter used in the degraissant. The vessels are invariably burnished above the shoulder. Decoration is limited to a few vessels bearing incised designs.

Fig. 72

Type 209. Jar of medium fabric with a flaring rim, globular body and burnished exterior. Unstratified *Variant 209a,* with a short everted rim. From late level. *Variant 209b,* with a projected rim. Painted with incised notches and wavy lines on the shoulder. From late level.

Type 210. Jar of medium fabric with a flaring rim, globular body and ribbed shoulder. Burnished above shoulder. From middle level. *Variant 210a,* with a carinated shoulder. Squattish. From surface.

Type 211. Jar of medium fabric with an everted rim, ribbed and shoulder. From late level. *Variant 211a,* with a ledged rim and neck. From late level.

Type 212. Vase of medium fabric with a footed base. Unstratified.

Type 213. Dish of medium fabric with a thick flaring rim, carinated shoulder and sagger base. Finger-tip designs on the interior. From late level. *Variant 213a,* thinner and deeper. From late level.

Type 214. Dish of medium fabric with a short obliquely cut rim, carinated shoulder and sagger base. Finger-tip designs on the interior. From late level.

Type 215. Dish of medium fabric with a flaring rim, externally grooved and bulbous body. Unstratified. *Variant 215a,* with a short projected rim. From late level.

Type 216. Bowl of thin fabric with a featureless rim and convex sides. From late level.

Type 217. Lamp of medium fabric with an incurved rim and narrow flat base. From late level.

Type 218. Lid of thick fabric with an obliquely-cut rim, tapering sides and round base. Unstratified.

(iv) *Black-and-red- ware*

The black-and-red ware continuously occurring in the Harappan and post-Harappan levels at Lothal and Rangpur provides an important link between the chalcolithic cultures of Central India and Northern Deccan on the one hand and the Harappa culture on the other. It is found in very small quantities in the Harappan context at the more northerly sites such as Rupar, Kot diji and Alamgirpur. From what has been said earlier (above p. 398) it appears that the authors of the Micaceous Red Ware were themselves responsible for producing the black-and-red ware also. The most important centre of the black-and-red ware industry in the chalcolithic period was Mewar and to a lesser extent Malwa. The earliest level of Navdatoli is dated 2100 B.C. on the basis of carbon-14 dates[1] and that of Ahar to 1800 B.C.[2] Phase I of Eran, which has also yielded the black-and-red ware is dated 2035 B.C.[3]. Unless it is established that the earlier levels of Navdatoli and Ahar, where

[1]Information kindly supplied by Dr. H. D. Sankalia.

[2]B. B. Lal, 'A picture emerges: An assessment of the Carbon-14 datings of the Protohistoric cultures, of the Indo-Pakistan Sub-continent *Ancient India,* 18-19, pp. 208-220.

[3]S. R. Rao *op. cit.* 1963, figs, 15 and 44.

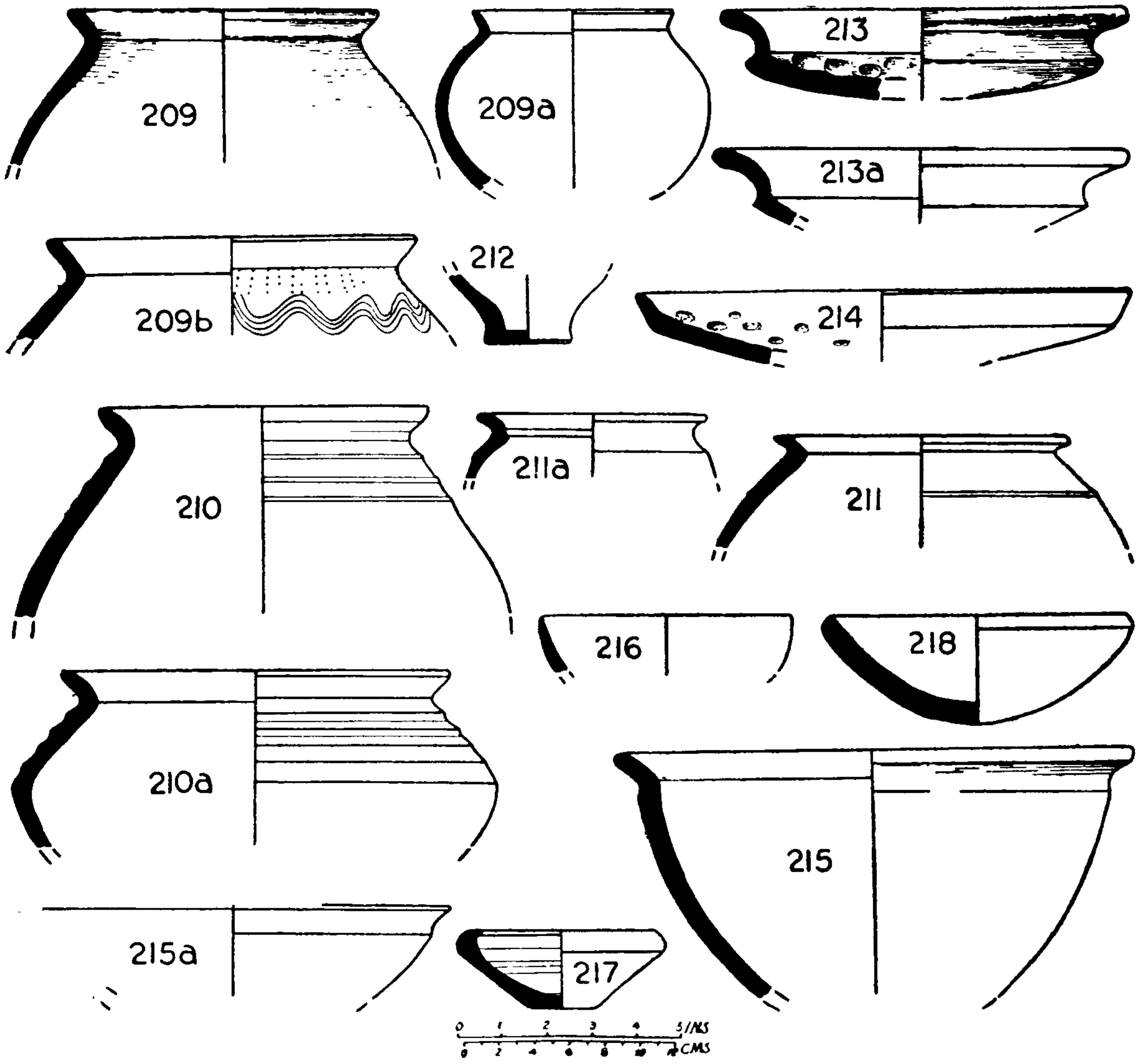

FIG. 72. *Coarse grey ware, Period A, Types 209-218*

the black-and-red ware is found in considerable quantity, were atleast contemporary with, if not anterior to, phase I of Lothal A which is dated to 2450 B.C. it cannot be said that Lothal borrowed the technique from the chalcolithic cultures of Central India. This argument holds good in the case of the chalcolithic-neolithic cultures of the Deccan also. In surface treatment and decoration the black-and-red ware varies from region to region in the same period and from one period to another at any given site. It is only the technique of inverted firing which was common to all the sites, but not the shapes or the treatment or the decoration of the vessels surface. Vessels of identical shapes and fabric are noticed in the in the Micaceous Red Ware and the black-and-red ware at Lothal and in the Lustrous Red Ware at Rangpur, but elsewhere in Central India and Deccan the shapes vary. The technique of inverted firing does not appear to have been very popular in the Harappan period in Gujarat and it was almost unknown in the Indus Valley proper. In Central India it was in use mostly in the Late Harappan times. In the post-Harappan days, the black-and-red ware was popular in Gujarat and Central India down to the N.B.P. period. Before the Painted Grey Ware (PGW) people arrived on the scene it was the most popular ware in the Ganga-Yamuna doab, and its use continued in post- PGW period also. This ware was produced by the chalcolithic-neolothic folk and later by the megalith-neolithic folk of Central Deccan and still later by the megalith-builders of the south, but with a difference in shapes and surface treatment. Thus it will be seen that the technique of inverted firing introduced by the Micaceous Red Ware people of Lothal was adopted on an extensive scale by the post-Harappans. The link between the neolithic-chalcolithic folk and the megalith-builders of the South provided by the black-and-red ware is still very weak.

A word may be said about the technique of inverted firing. While firing the pot the oxidisation of iron-compounds was prevented and the destruction of carbonaceous materials used as degraissant was complete, which was responsible for the black colour all over the interior and partly on the rim and below on the exterior. The rest of the exterior surfce fired under oxidising conditions turned red. In the case of the vessels from Lothal a slip was applied and the surface burnished before firing. The core is altogether smoky and a thin layer of the outer surface is red.

The black-and-red ware vessels from Ahar are painted in white on the exterior or on both the surfaces, and those from Lothal are painted on the interior only in dirty white colour. Occasionally, black is also used for painting on the vessels from Lothal.

The painted designs noticed at Lothal and Rangpur include simple dots, dots-and-strokes, wavy lines in groups and hatched circles (fig. 73, *221*). The vessels from Ahar are however painted with lozenges, hatched and concentric circles, cross-hatched panels, zigmas and zig-zag lines in dots.

The shapes in the black-and-red ware very few. The bowls are convex-sided in Period A and blunt-carinated in Period 'B' (pl. CLXX B). A sharp carination is noticed on the shoulder of the vessels in Rangpur IIC and III[1] and Ahar I. Other shapes found in this ware at Lothal are the small basin, the bowl with a stud-handle and the dish.

Fig. 73

Type 219. Bowl of thin fabric with a featureless rim and convex sides. From middle level. *Variant 219a,* is shallow. From middle level. *Variant 219b,* with a slightly incurved rim. *Variant 219c,* larger and deeper. *Variant 219d,* of smaller size and black in the upper half on the exterior also. *Variant 219e,* with a sharp edged

[1]Cf S. R. Das *op. cit.* 1963, fig. 15 and 44

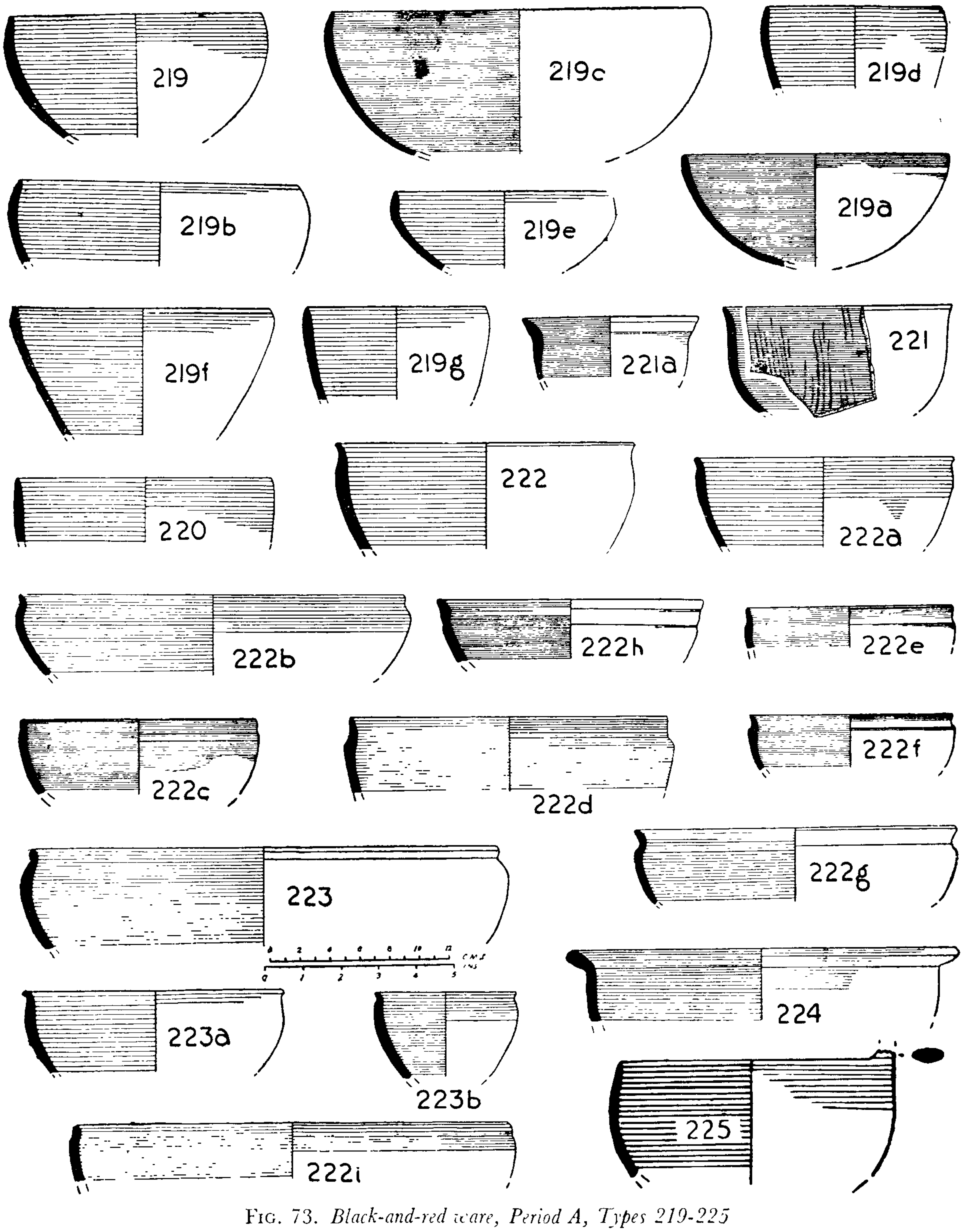

FIG. 73. *Black-and-red ware, Period A, Types 219-225*

incurved rim. From late level. *Variant 219f,* with a thick rim and tapering sides. From late level. *Variant 219g,* with a knife-edged rim. From middle level.

Type 220. Bowl of thin fabric with a straight sharp edged rim. From late level.

Type 221. Bowl of thin fabric with an everted rim and blunt carinated shoulder. Painted with black oblique strokes on the interior. From late level. *Variant 221a,* with a thick everted rim. From late level.

Type 222. Bowl of thin fabric with a short everted under-cut rim. From early level. *Variant 222a,* with thin sides. From early level. *Variant 222b,* with a blunt carinated shoulder. From early level. *Variant 222c,* a slightly-everted rim, the undercut being inconspicuous. From middle level. *Variant 222d,* with a sharp flaring carinated rim. From middle level. *Variant 222e,* with an inconspicuously carinated rim. From middle level. *Variant 222f,* of small size and thin fabric with an everted and carinated rim. From early level. *Variant 222g,* with a flaring deep carinated rim. From middle level. *Variant 222h,* with a thick inconspicuously carinated rim. From late level. *Variant 222i,* with a straight and slightly carinated rim. From late level.

Type 223. Bowl of thin fabric with a beaded rim and bulbous body. From late level. *Variant 223a,* with a short everted rim. From late level. *Variant 223b,* small size. From middle level.

Type 224. Bowl of medium fabric with a thick projected rim and bulbous body. From early level.

Type 225. Bowl of thin fabric with a straight sharp rim and stud handle. From late level.

D. Painted Sherds of Period A

Fig. 74

A1. Sherd painted on the exterior in black over red with a stag standing below a tree. Well -proportioned body, long branching-off horns. Noted for realism and easy flow of lines. An example of Provincial Style. Red ware of medium thickness. Pl. CLXXXIX.

A2. Sherd painted with a large fish almost looking like a whale in black over red. Water indicated by wavy lines enclosed by horizontal lines. Micaceous Red Ware of medium fabric. Pl. CLXXIA.

A3. Sherd painted in purplish brown over greenish buff with a row of stylised dancing figures hand-in-hand. Limbs indicated by lines. Buff Ware of medium fabric. Pl. CLXXII A, *1.*

A4. Sherd painted in black over red on the exterior with two birds with long legs and neck; perhaps starks; both on the move. Red Ware of medium fabric. Pl. CLXXIIA, *2.*

A5. Sherd painted in blackover redwith a peacock. Hatched body and open plumes. Movement indicated

A5. Sherd painted in black over red with a peacock. Hatched body and open plumes. Movement indicated. Red Ware of medium fabric. Peacocks on Indus Valley pottery have a longer body and thick and long plumes. Stylisation noticeable at Lothal in later levels. Pl. CLXXII A, *3.*

A6. Sherd painted in black over red on the exterior with two snakes, one entering the anti-hill and the other emerging from it. Vegetation near ant-hill indicated by oblique lines. Motifs representing the sun in circles enclosed by two horizontal bands. Red Ware of medium thickness. An example of Provincial style. Pl. CLXXIIA, *4.* Snakes are also painted at Mohenjo-daro[1] Harappa[2] and Chanhu-daro.[3].

A7. Sherd painted in black over red on the exterior with two snakes springing from the ground below a tree. Look as if hissing. Three horizontal lines and a loop painted below the tree and snakes. Red Ware of medium fabric. An example of Provincial style. Pl. CLXXII A, *5.*

A8. Sherd painted in black over light red on the exterior with two snakes in a highly stylised form indicated by two zigzag lines enclosed between horizontal lines both above and below. Micaceous Red Ware of medium fabric. Pl. CLXXII A, *6.* Snakes are painted at Harappa and Mohenjo-daro.

A9. Sherd painted in purplish brown over red on the exterior with two aquatic birds holding a fish in their beaks and about to fly away. Wings slightly spread, body of the birds and fish hatched. Cross-hatched

[1]Marshall, *Op. cit.* 1931, III, Fig. 23, pl. XCII.
[2]Vats, *Op. cit.* 1950, II, pl. LXIX.
[3]Mackay, *Op. cit.* 1943, fig. 5, pl. XXX.

FIG. 71. *Painted sherds, Period A, A1 to A 20*

rectangle enclosed on all sides by horizontal and vertical lines and the entire scene drawn between horizontal lines. Red Ware of thin fabric. An example of Provincial style. Pl. CLXXII B.

A10. Sherd painted in black over a light red to buff slip with a pair of cranes facing to right above three horizontal lines. Body hatched. Red Ware of medium fabric. An example of Provincial style. Pl. CLXXIC.

A11. Sherd painted in deep black over red on the exterior with pipal branches. Leaves hatched. Red Ware of medium fabric. An example of the Harappan style.

A12. Sherd painted in light black over a red on the exterior with pipal tree and two peacocks, Hind parts of peacock with cross-hatched body and short plumes perched on the tree visible. Red Ware of medium thickness. Peacocks more or less similarly represented on the Indus Valley pottery. An example of the typical Harappan style. Pl. CLXXII B, *2.*

A13. Sherd painted in black over red on the exterior with hatched leaves, perhaps, of pipal. Hind part of a peacock with long plumed tail with eye design also visible. An example of typical Harappan style.

A14. Sherd painted in black over red on the exterior with a plant motif. Pigment flaking off. Red Ware of medium fabric. Motif not known in the Indus Valley.

A15. Sherd painted in black on red on the exterior with a hatched and a plain leaf besides a twig or tendril below two horizontal lines as on Indus pottery. Red Ware of medium fabric. Harappan style.

A16. Sherd painted in black over red on the exterior with two hatched leaves, above two horizontal bands. Red ware of medium fabric. Slip flaking off. Similar design noticeable in Indus Valley.

A17 Sherd painted in deep black over red on the exterior with a plantain tree motif. Long parallel leaves hatched. Red Ware of medium fabric. Occurs at other mature Harappa sites also.

A18. Sherd painted in black over red on the exterior with a thorny plant. Thorny leaves indicated by strokes. Red Ware of medium fabric. Slip peeling off. Pl. CLXXIII A, *1* Motif rarely occurs at Indus sites

A19. Sherd painted in black over brownish red on the exterior with a hatched leaf with broad-tip-end besides two palm leaves ending in opposite directions. Horizontal bands also visible above. Red Ware of medium fabric. Pl. CLXXIII A, *2.* Similar palm leaves noticeable in Indus Valley pottery also.

A20 Sherd painted in deep black over deep red on the exterior with hatched leaf and tips of the stern designs. Red Ware of medium fabric. Pl. CLXXIII A, *3.*

Fig. 75

A21. Sherd painted in deep black over red on the exterior with two twigs represented by strokes on arcs. Red Ware of medium fabric. Pl. CLXXIII A, *4.* Occurs occasionally on Indus Valley pottery too.

A22. Sherd painted in orange red over black on the exterior with a plant motif. Pinnately compound leaves indicated by strokes on one of the stems. Red Ware of medium fabric. Pl. CLXXIII A, *5.*

A23. Sherd painted in black over red on the exterior with leaves of the palm and pointed types, the former indicated by strokes and thel atter by hatching the body. Red Ware of medium fabric. An example of the Harappan style of painting plant motif. Pl. CLXXIII A, *6.*

A24. Sherd painted in black over red with the motif of exterior twigs. Red Ware of medium fabric. Pl. CCCL- XXXIV, *7.* Noticeable at Indus Valley sites.

A25. Sherd painted in black over red on the exterior with an acacia-like tree. Red Ware of medium fabric. Pl. CLXXIII A, *8.* Vaguely resembling plants noticed at Chanhu-daro and Mohenjo-daro.

A26. Sherd painted in black over buff ont he exterior with two conventionalised leaves indicated by strokes on two oblique lines below two horizontal bands. Buff Ware of medium fabric. Pl. CLXXIII A, *9.* Occurs as a ubordinate motif on Indus Valley pottery.

A27. Sherd painted in purplish brown on buff on the exterior with a hatched leaf and some strokes one below the other. Red Ware of medium fabric. Pl. CLXXIII A, *10.* Occurs in the Indus Valley also.

A28. Sherd painted in black over greenish slip on the exterior with a hatched leaf with midrib below horizontal. band Greenish ware of medium fabric. Pl. CLXXIII A, *11.* Occurs in Jhukar level of Chanhu-daro also.

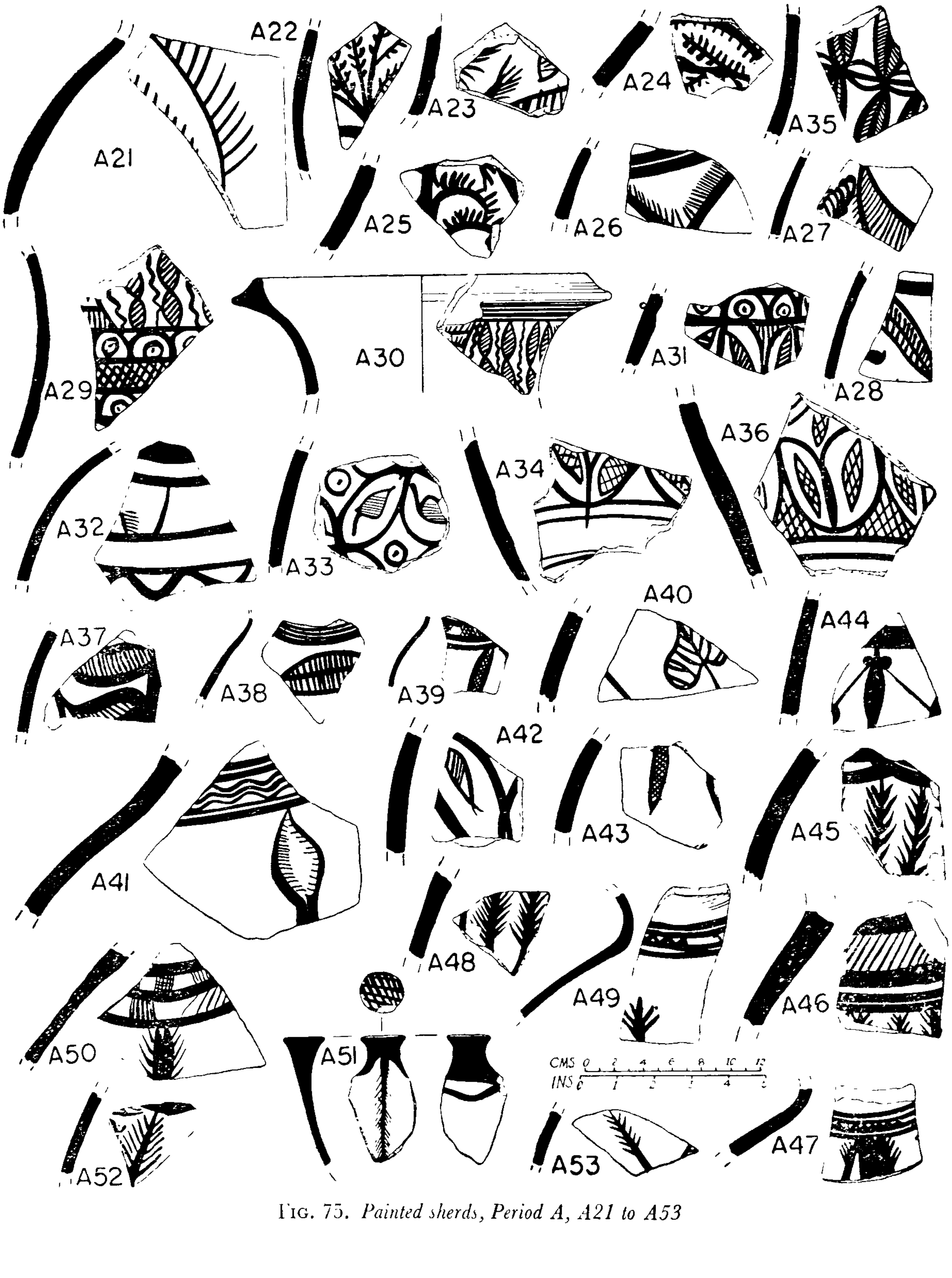

FIG. 75. *Painted sherds, Period A, A21 to A53*

A29. Sherd painted in deep black over a fine red slip in four horizontal registers on the exterior; hatched panel found separating two rows of semi-circles enclosing the circle-and-dot; hatched double leaf and wavy line painted alternately in the lowest panel. Red Ware of medium fabric. Harappan style. Pl. CLXXIII B, *1*.

A30. Sherd painted in deep black over fine a red slip on the exterior with wavy line and hatched double leaf alternately below four horizontal bands. Red Ware of medium fabric. Example of derivative leaf pattern in Harappan style. Pl. CLXXIII B, *2*.

A31. Sherd painted in black over red in two horizontal registers on the exterior with leaf pattern produced by hatching interspace between arcs enclosed by a loop. Space between loops also hatched. Row of circle-and-dots enclosed by semi-circle in the upper register. Red Ware of medium fabric. Pl. CLXXIII B, *3*.

A32. Sherd painted in black over a light red slip on the exterior with a horizontal wavy line and hatched leaf like design enclosed between two horizontal bands. Another band seen at the top. Red Ware of medium fabric. Pl. CLXXIII B, *4*.

A33. Sherd painted in black over red on the exterior. Hatched leaf design enclosed by interlacing semi-circles and arcs. Circle-and-dot occurring in the interspace enclosed leaves. Red Ware of medium fabric. Harappan style. Pl. CLXXIII B, *5*.

A34. Sherd painted in black over red on the exterior with cross-hatched leaf patterns enclosed by intersecting semi-circles. Two sets of double horizontal bands noticed at the top. Red Ware of medium fabric. Harappan style. Pl. CLXXIII B, *6*.

A35. Sherd painted in black over red on the exterior with semi-naturalistic leaf and flower design by hatching the space between arcs enclosing the vertical lines. The horizontal line also enclosed by loops but space not hatched. Red Ware of medium fabric. Harappan style. Pl. CLXXIII B, *7*.

A36. Sherd painted in black over red on the exterior with a series of intersecting loops-enclosing cross-hatched leaf patterns; interspace between loop also cross-htched. Red Ware of medium fabric. Harappan style. Pl. CLXXIIIB, *8*.

A37. Sherd painted in black over red on the exterior with two hatched leaves on one side of a stern. Red Ware of thin fabric. Pl. CLXXIIIB, *9*. Occurs in the Indus Valley also.

A38. Sherd painted in black over red on the exterior with a hatched leaf below four horizontal bands. Red Ware of thin fabric.

A39. Sherd painted in black over a light red slip on the exterior with a leaf design by cross-hatching the narrow space between two thick arcs. Cross-hatched panel between horizontal bands noticed above the leaf. Micaceous Red Ware of this fabric. An example of five brush work on indigenous ware.

A40. Sherd painted in light black over red on the exterior with pipal leaf which is more realistic than that of the Harappan style. Red Ware of medium fabric.

A41. Sherd painted in black over red with a leaf and strokes on the inner margin of the leaf. Three wavy lines enclosed by double horizontal bands. Micaceous Red Ware of medium thickness.

A42. Sherd painted in black over red on the exterior with a hatched fish or leaf enclosed by thick arcs One more leaf (?) springing from the above is visible. Red Ware of medium fabric. Occurs in the Indus Valley also.

A43. Sherd painted in black over a micaceous red slip on the exterior with a long cross-hatched leaf as in 2 above. Micaceous Red Ware of medium fabric. Example of fine brush work.

A44. Sherd painted in black over red on the exterior with a maize pod and two oblique lines each terminating in a pellet. A thick horizontal band also visible above maize pod. Red ware of medium fabric.

A45. Sherd painted in black over a light red micaceous slip on the exterior with two wheat (?) plants below intersecting loop leaf blades carefully drawn. Micaceous Red Ware of medium fabric. Example of vegetable motifs drawn in indigenous style. Pl. CLXXIV A, *1*.

A46. Sherd painted in black over light red on the exterior with a row of wheat (?) plants below horizontal bands. Upper register hatched with oblique lines and enclosed between horizontal bands. Micaceous Red Ware of medium fabric. Example of indigenous style. Pl. CLXXIV A, *2*.

A47. Sherd painted in black over a light red slip on the exterior with plant-like motifs below four horizontal bands, enclosing a zigzag line. Micaceous Red Ware of medium fabric. Pl. CLXXIV A, *3.*

A48. Sherd painted in black over an orange slip, on the exterior with two wheat plants and a vertical line. Micaceous Red Ware of medium fabric. Indigenous style. Pl. CLXXIV A, *4.*

A49. Sherd painted in black over light red on the exterior with a plant motif below four horizontal bands enclosing a zigzag line. Micaceous Red Ware of medium fabric. Indigenous style. Pl. CLXXIV A, *5.*

A50. Sherd painted in black over light red on the exterior with a wheat chaff (?) below three horizontal bands enclosing groups of vertical and oblique strokes in the lower register and a hatched square and vertical strokes in the upper one. Micaceous Red Ware of medium fabric. Indigenous style. The conception of painting oblique and vertical lines in groups revived in Period B. Pl. CLXXIV A, *6.*

A51. Sherd painted in black over red with a wheat plant or feather design on the interior, a wavy line below a horizontal band on the exterior and a criss-cross on the stud handle. Micaceous Red Ware of thin fabric. Indigenous style. Pl. CLXXIV A, *7.*

A52. Sherd painted in purplish brown over orange on the exterior with a plant motif below horizontal band. Micaceous Red Ware of medium fabric. Pl. CLXXIV A, *8.*

A53. Sherd painted in black over red on the exterior with twigs design part of which is visible. Red Ware of medium fabric. Occurs in a more stylised form in Period B. Pl. CLXXIV A, *9.*

Fig. 76

A54. Sherd painted in black over red on the exterior with two superimposed rows of arches each enclosing a plant. Red Ware of thick fabric. Example of Harappan style.

A55. Miniature vessel with 'S'-profile painted in black over buff with a deer looking back with surprise at a bird, which has perhaps something to do with a pot-like object. Two gently bending trees separate the crow, pot and deer from one another. The forward stretched leg of the deer suggests movement. Perhaps the potter has in view the story of the 'thirsty deer and the crow'. The latter succeded in drinking water from a narrow-mouthed vessel whereas the former had failed. The figures are all carefully painted with a fine brush and the animals are most realistic. The body of both the animals is hatched. The whole panel is en losed by two horizontal bands below and one above Red Ware of thin fabric. Fine example of Provincial style. Pl. CLXXIV B,

A56-A57. Sherd painted in black over orange red on the exterior with a boat having multiple oars and enclosed by horizontal bands. Water indicated by groups of zigzag lines running obliquely and enclosed by oblique lines. Micaceous Red Ware of medium fabric. Pl. CLXXV A. A boat with sails and oar is engraved on a potsherd from Mohenjo-daro.

Fig. 77

A58. Sherd painted in black over red on the exterior with two vertical lines across eight horizontal ones thus producing an almost hatched rectangle. Red Ware of medium fabric.

A59. Sherd painted in black over buff on the exterior with three horizontal bands. Red Ware of medium fabric.

A60. Sherd painted in black over buffish green and red slips on the exterior with horizontal lines above a series of vertical lines. Buff slipped Ware of medium fabric.

A61. Sherd painted in purplish brown over a greenish slip on the exterior with three horizontal bands and an oblique line. Green ware of medium fabric.

A62. Sherd painted in purple over a buffish wash on the exterior. Buff Ware of thin fabric.

A63. Sherd painted in black over light red on the exterior with a series of loop-like wavy lines enclosed by double horizontal bands. Micaceous Red Ware of medium fabric.

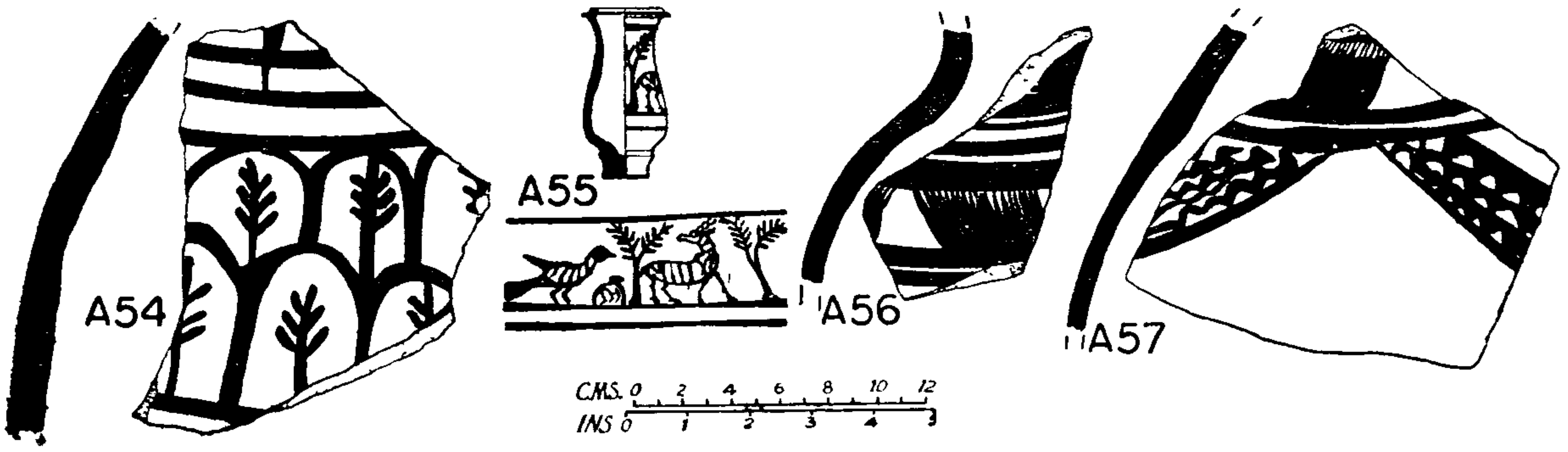

FIG. 76. *Painted sherds, Period A, A54 to A57*

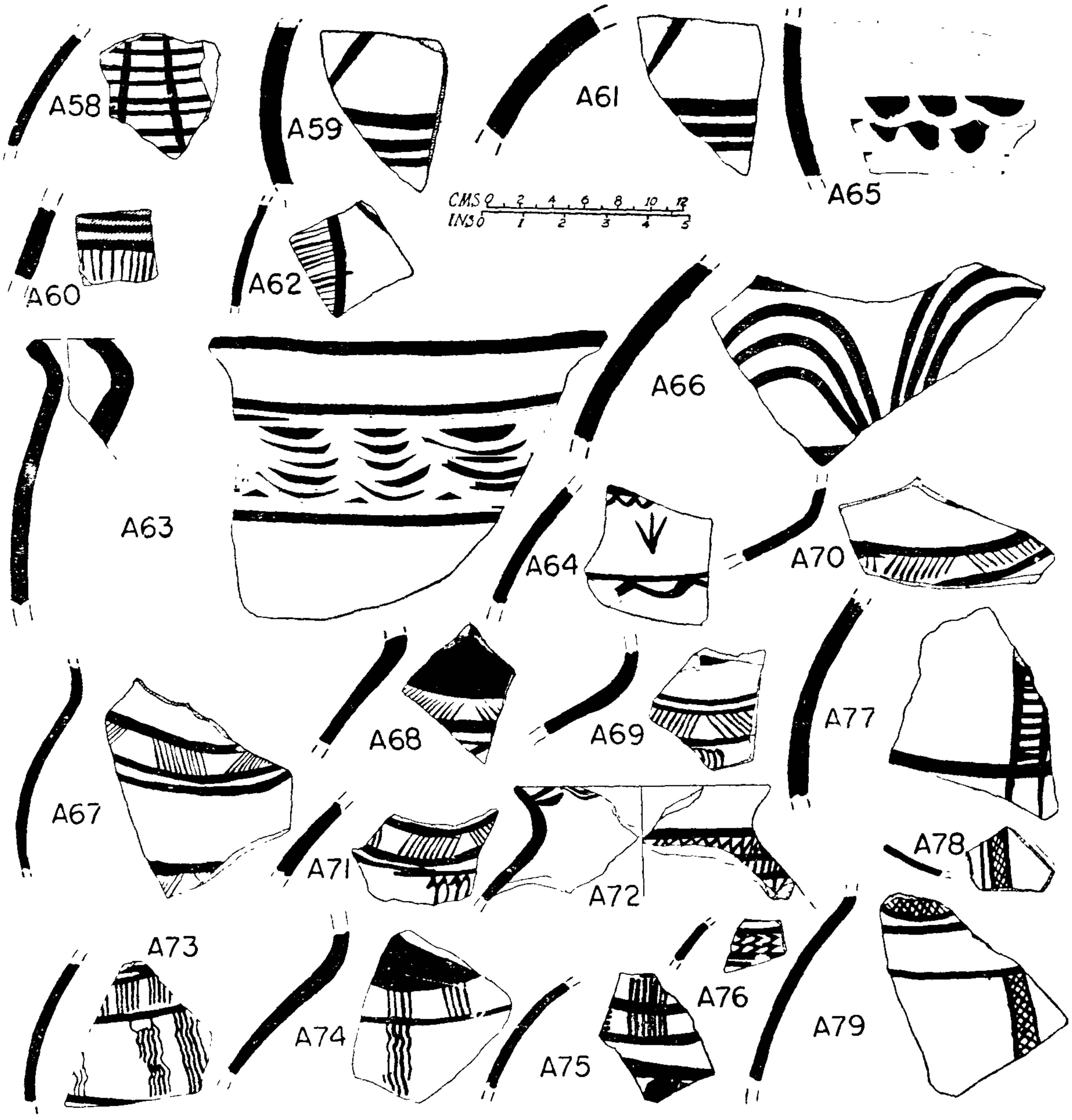

FIG. 77. *Painted sherds, Period A, A58 to A79*

A64. Sherd painted in black over red on the exterior with a trident between two horizontal bands each attached to a wavy line. Micaceous Red Ware of medium fabric.

A65. Sherd painted in black over light red on the exterior with a series of loops in two rows enclosed by horizontal bands. Micaceous Red Ware of medium fabric.

A66. Sherd painted in purplish brown over a greenish background on the exterior with two groups of three inverted loops each emerging from a point on a horizontal band. Green ware of medium fabric. Occurs in Rangpur IIC also.

A67. Sherd painted in black over orange red on the exterior with groups of oblique lines enclosed by horizontal bands in the upper register. Another group of oblique lines seen below a horizontal line in the lower register. Micaceous Red Ware of medium fabric. Indigenous style repeated in Period B.

A68. Sherd painted in black over light red on the exterior with two groups of oblique line between thick horizontal bands, above and a thin one below. Micaceous Red Ware of medium thickness.

A69. Sherd painted in black over light red on the exterior with two groups of oblique lines enclosed by horizontal bands above a culvilinear design. Micaceous Red Ware of medium fabric. Also occurs in Rangpur IIC.

A70. Sherd painted in black over orange red on the exterior with oblique lines in three groups enclosed by horizontal bands. Micaceous Red Ware of medium fabric.

A.71 Sherd painted in purplish brown over orange red on the exterior with oblique lines in groups enclosed by horizontal bands above small arches. Micaceous Red Ware of medium fabric. Occurs in Rangpur IIC and III and the Jhukar levels of Chanhu-daro.[2]

A72. Sherd painted in black over orange red on the exterior with rows of zigzags and vertical strokes each enclosed by horizontal bands. Micaceous Red Ware. Indigenous style.

A73. Sherd painted in black over light red on the exterior with flowing vertical wavy lines in two groups below groups of vertical lines enclosed by horizontal bands. Micaceous Red Ware of medium fabric. Indigenous; style occurs in Period B in Rangpur IIC and Jhukar levels of Chanhu-daro.[1]

A74. Sherd painted in black over orange-red on the exterior with a group of flowing vertical wavy lines in the lower register and with vertical lines in groups in the upper register enclosed by hotizontal bands. Micaceous Red Ware of medium fabric. Indigenous style.

A75. Sherd painted in black over light red on the exterior with vertical lines in two horizontal registers enclosed by bands. A vertical row of strokes is seen in the lower of the two registers. A horizontal band and a circular patch also painted below. Micaceous Red Ware of medium fabric Indigenous style repeated in Period B also. Occurs in Rangpur IIC.

A76. Sherd painted in black over light red on the exterior with a series of Sigma-like wavy lines enclosed between horizontal bands. Micaceous Red Ware of medium fabric.

A77. Sherd painted in black over a partially applied red slip on the exterior with a ladder pattern across a horizontal band. Red Ware of medium fabric.

A78. Sherd painted in white over light red on the exterior with a hatched ladder design. Micaceous Red Ware of thin fabric. Indigenous style repeated in Period B. Occurs in Rangpur also.

A79. Sherd painted in white over red on the exterior with a cross-hatched panel below two horizontal bands. Red Ware of medium fabric.

Fig. 78

A80. Sherd painted in black over a bright red slip on the exterior with two oblique lines with a series of strokes resembling plant motif below three horizontal bands enclosing two successive rows of oblique and vertical lines. Red Ware of thin fabric. Indigenous style.

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[1]Mackay, *Excavations at Chanhu-daro,* 1943, Pl. XLII, 22.

[2]Mackay *op. cit.* 1943, pl.XXX. 2 and 7.

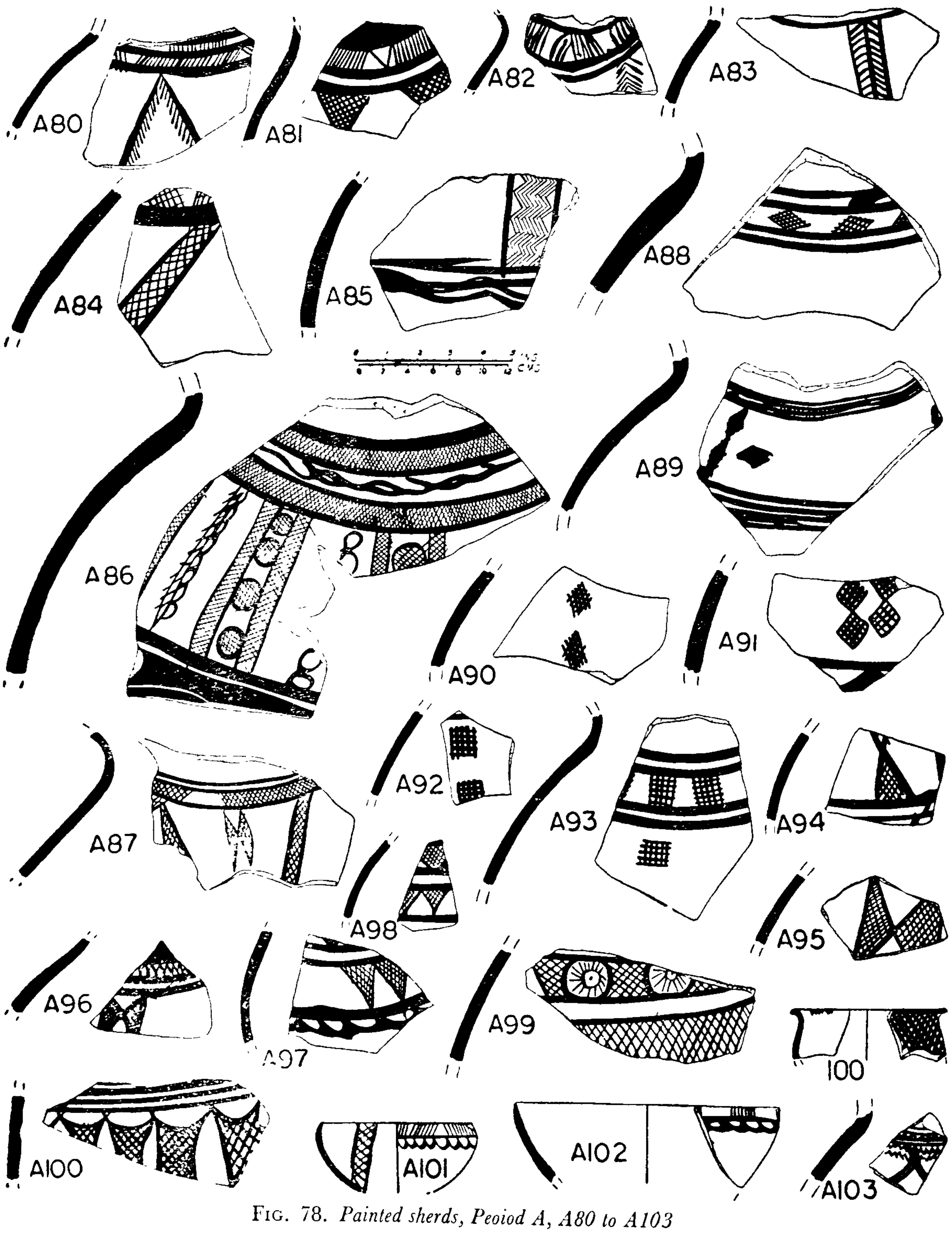

FIG. 78. *Painted sherds, Peoiod A, A80 to A103*

A81. Sherd painted in purplish brown on light orange-red on the exterior with two cross-hatched panels in the lower register and oblique lines in groups enclosed by horizontal bands in the upper register. Micaceous Red Ware of medium fabric.

A82. Sherd painted in black over light red on the exterior with a vertical row of chevrons below groups of oblique and vertical lines enclosed by horizontal bands. Micaceous Red Ware of thin fabric. Also occurs in Jhukar levels of Chanhu-daro and at Bara.

A83. Sherd painted in purplish brown over an orange red slip on the exterior with a ladder-like design produced by joining three vertical lines with oblique strokes. A horizontal band also seen above. Micaceous Red Ware of medium fabric.

A84. Sherd painted in purplish brown over light red on the exterior with a row of cross-hatched triangles above a horizontal band below which is drawn an obliquely running cross-hatched ladder. Micaceous Red Ware of medium thickness.

A85. Sherd painted in purplish brown over a light red slip with a vertical panel of herring bone design demarcated by a vertical line. Below are seen a horizontal band and two wavy lines. Micaceous Red Ware of medium fabric. Herring bone pattern occurs at Mohenjo-daro, Harappa and Rangpur and in Jhukar levels of Chanhu-daro.[1]

A86. Sherd painted in purplish brown over buff on the exterior alternately with chain and ladder motifs. A vertical row of cross-hatched circles between ladder-like hatched panels flanked by chain like motifs. The upper register painted alternately with horizontally running chain and cross-hatched bands, Micaceous Red Ware of medium fabric. Pl. CLXXV B, *1.*

A87. Sherd painted in black over light red on the exterior with cross-hatched oblique panels below horizontal and cross hatched bands. Cross-hatched double-triangles noticed between obliquely running panels. Micaceous Red Ware of medium fabric. Pl. CLXXV B, *2.*

A88. Sherd painted in black over light red on the exterior with a row of hatched enlongated diamonds enclosed between double horizontal bands. Micaceous Red Ware of medium fabric.

A89. Sherd painted in black over red on the exterior with a vertical row of hatched diamonds and another beside it between two groups of horizontal bands of ununiform thickness. Micaceous Red Ware of medium fabric. An example of crude work.

A90. Sherd painted in black over orange red slip on the exterior with two hatched diamonds one below the other. Micaceous Red Ware of medium fabric.

A91. Sherd painted in black over orange red slip on the exterior with two vertical rows of hatched diamonds above a horizontal band. Another indeterminate design partially visible below. Micaceous Red Ware of medium fabric. Occurs at Rangpur in IIA and IIC[2].

A92. Sherd painted in black over light red on the exterior with compartmented squares one below the other. Micaceous Red Ware of medium fabric.

A93. Sherd painted in black over light red on the exterior with a horizontal row of compartmented rectangles enclosed between two groups of double horizontal bands. A compartmented square also visible. Micaceous Red Ware of coarse fabric. Occurs in Rangpur II.

A94 Sherd painted in purplish brown over light red on the exterior with cross-hatched triangles in a vertical panel between intersecting lines above two horizontal bands Micaceous Red Ware of medium fabric. Occurs in a horizontal panel in the Harappa Jhukar levels at Chanhu-daro.[3]

A95. Sherd painted in black over light red on the exterior with hatched and juxtaposed triangles meeting at the apex. Micaceous Red Ware of medium fabric. Occurs at Rangpur in IIC-.[4]

A96. Sherd painted in black over orange red on the exterior with the design described in 8 above. Also zigzag line enclosed between horizontal bands above. Micaceous Red Ware of medium fabric.

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[1]S. R. Rao *op. cit,* 1963, figs. 26 and 33.
[2]S. R. Rao, *op. cit,* 1963, figs. 26 and 33.
[3]Mackay *op. cit.* 1943, pl. XXX, *21.*
[4]S. R. Rao *op. cit.* 1963, fig. 34, *5h.*

A97. Sherd painted in purplish brown over light red on the exterior with two cross-hatched inverted triangles enclosed between bands in lower panel. Micaceous Red Ware of medium fabric.

A98. Sherd painted in black over light red on the exterior with a row of cross-hatched inverted triangle enclosed between horizontal bands. A hatched diamond enclosed partially visible above. Micaceous Red Ware of medium fabric.

A99. Sherd painted in black over red on the exterior with a row of rayed-circles with a dot in the centre suggesting sun-motifs enclosed in circles in the upper panel the interspace being cross-hatched. Lower panel cross-hatched. Red Ware of medium fabric.

A100. Sherd painted in purplish brown over red on the exterior with a row of open nets below horizontal bands. Red Ware of medium fabric. Occurs at most of the Harappa sites in the Indus Valley.

A101. Sherd painted in black over a bright red slip on the exterior with loops suspended from a horizontal band above which groups of oblique lines are noticed. Interior painted with cross-hatched panel. Micaceous Red Ware of thin fabric.

A102. Sherd of painted in black over light red on the exterior with thick suspended loops below a horizontal band above which vertical strokes are noticed. Interior painted with a row of stylised birds which look like arrow-heads. Micaceous Red Ware of thin fabric.

A103. Sherd painted in black over orange red on the exterior with two horizontal wavy lines below horizontal bands enclosing another zigzag line. Two double loop-like arcs starting from the same point also Micaceous Red Ware of medium fabric.

E. Incised Ware

The bulk of the incised ware which however is very limited in quantity comes from the middle and upper levels of Period A and is confined to the Harappan and coarse gritty wares. The designs impressed or engraved are simple and consist of intersecting circles, spirals with radiating rays, floral and cord designs, scoured horizontal, wavy or criss-cross lines, loops and herring bone designs. Nail-tip and finger-tip marks and notches produced by a sharp instrument or thorn are also noticed. Incised patterns were mostly limited to the coarse red and coarse grey wares. Cord design was however impressed on the superior wares of red and buff fabric also.

5. Pottery of Period B.

The poorer fabric, indifferent application of the slip, the carelessness shown in painting the vessels, the gradual disappearance of certain ceramic forms e.g. goblet, beaker and perforated vessels, and the scarcity of the Buff Ware in Period B have been referred to in Chapter III. The most striking features of the ceramic art of Period B are the evolution of new ceramic types and further simplification of the painted designs. The stages of evolution of the bulbous jar with a low neck into an ovoid one with a high neck, the convex-sided bowl into a concavo-convex-sided bowl and the carinated dish into a non-carinated one have been noted earlier (above p. 340ff). The stud-handle of the bowl became elongated in phase V and the rectangular rim of the storage jar becomes excurved or beaded. In the thick Harappan red ware the main types are jars and basins; In the thinner variety the beaker disappeared gradually along with the perforated vessel of thick fabric. The coarse grey ware and coarse red ware become more popular. The high-necked jar and carinated bowls occur in the thinner variety of Harappan red ware. The indifference shown in painting the naturalistic and geometric patterns comes to notice for the first time in phase IV. This feature continued in Period B when the vessels were painted over a limited surface with certain elementary designs. A careful study of the ceramic wares from well-

stratified deposits from the excavations at Harappa[1] and Mohenjo-daro conducted in the years 1946 and 1950 respectively reveal a decadence in the ceramic art of the late phase of the Harappa civilization. The indifference shown in executing the typical Harappan motifs can be seen also on the earthenwares from earlier excavation at Mohenjo-daro.[2] The decadence continued longer at Lothal and gradually the distinctive features of the Indus style of painting were lost along with those of the Provincial style in phase V. The preference for hatched triangles, horizontals, loops, fronds, wave-patterns in groups and zigzags became so marked that all other sophisticated naturalistic and semi-naturalistic motifs were dropped in a short time. Occasionally birds and plants were hurriedly painted in a stylized form (*B1-B14*). A few Indus motifs such as derivative leaf patterns and intersecting circles, alternately hatched squares etc., continued for a short while. On the whole the Indus style gradually gave place to a new style noted for loops, fronds and wavy lines.

The following ceramic wares occur in Period B, and the main types in each ware are briefly referred to below:

1. Red Ware 2. Buff-slipped Ware 3. Micaceous Red Ware 4. Coarse red ware 5. Coarse grey ware. 6. Prabhas Ware.	Harappan wares. Associated wares.

A. Harappa Wares.

(i) *Red Ware.*

Both Harappan and evolved forms are noticed in the Red Ware, which accounts for the bulk of the pottery of Period B. The main types are the storage-jar with a collared or projected rim (fig. 79, *227*), the high-necked jar (fig. 80, *234*), the lota-shaped vessel (fig. 96, *3*), the large squattish dish-on-stand (fig. 81. *242*), the carinated bowl (fig. 83,, *257*) and basin with a projected rim and bulbous body (fig. 82, *252*). The fabric is inferior owing to the use of sand and grit. The slip, light to dull red in colour, does not in some cases cover the striations which indicate the indifferent treatment of the surface. The vessels are normally painted in black and in a few cases in purple brown. The designs include the peacock, swan and other birds, plant and floral motifs and geometric patterns such as the arc, circle with dot, hatched diamond, triangle and rectangle. Other important designs, are wavy, oblique or vertical lines in groups, loops with fronds and the ladder. It can be said on the whole that the sophisticated Harappan designs were replaced by simple linear patterns.

Fig. 79

Type 226. Large storage-jar of medium fabric with a splayed rim, ledged shoulder and wide mouth. Red slip applied over buff wash on the exterior. From middle level.

Type 227. Large storage jar of medium fabric with a wide mouth, projected and internally grooved sides. From late level. *Variant 227a,* with a rectangular cross-section. From late level.

[1] R.E.M. Wheeler' Harappa 1946: The Defences and Cemetery R 37' *Ancient India* no. 3, fig. 15, XIh; fig. 16, XIIIa.

[2] Mackay 1938 pl. LXIX, 18 and 22. *op. cit.* II,

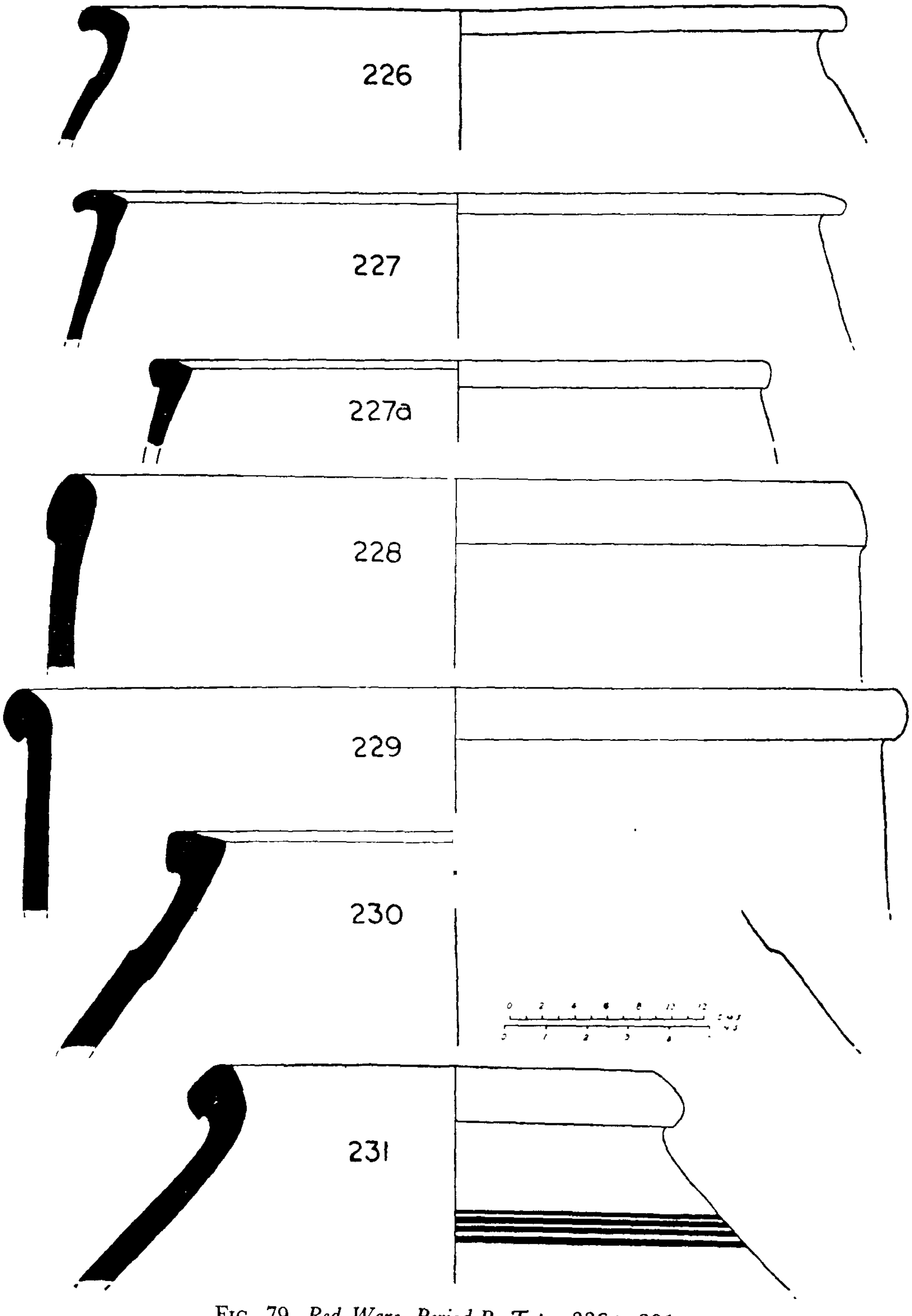

FIG. 79. *Red Ware, Period B, Types 226 to 231*

Type 228. Large storage-jar of thick fabric with an externally collared rim and bulbous body. From late level.

Type 229. Large storage jar of thick fabric with a beaded rim. Dark-red slip applied. From middle level.

Type 230. Large storage jar of thick fabric with a thick projected rim, narrow mouth, ledged shoulder and bulbous body. Rectangular cross-section. Painted in black over light-red with wide bands on the rim and neck. From early level.

Type 231. Large storage jar of thick fabric with a beaded rim and bulbous body. Bichrome, red slip applied on the shoulder and a white wash below. Black horizontal band on the junction visible. Wavy band on the rim. From middle level.

Fig. 80

Type 232. Storage jar of medium fabric with a wide mouth, ex-curved rim and ovoid body. Painted in black over red with horizontal bands on the rim and shoulder. From early level. *Variant 232a,* with an obliquely cut beaked rim. From late level. *Variant 232b,* with a beaked rim. Painted black over red with horizontal bands on the rim, neck and shoulder. From middle level.

Type 233. Jar of medium fabric with a beaded rim, short neck and bulbous body. From level. *Variant 233a,* with a slightly raised neck. Painted in black over red with horizontal bands on the rim and shoulder and concentric arcs below. From late level. *Variant 233b,* with a beaked rim, From middle level. *Variant 233c,* with a beaded rim, high neck and globular body. From middle level. *Variant 233d,* painted in black over red with horizontal bands on the rim and shoulder and two loops below. From middle level.

Type 234. Jar of medium fabric with a beaded rim and high concave neck. Painted in black over red with a horizontal band on the neck. From middle level. *Variant 234a,* with a prominent beaked rim. From middle level.

Type 235. Jar of medium fabric with a flanged rim, wide mouth and concave neck. From early level.

Type 236. Small jar of thin fabric with an obliquely-cut flaring rim. Painted in black over red with horizontal bands on the neck. From late level. *Variant 236a,* with a flaring mouth and globular body. From late level.

Type 237. Small jar of medium fabric with a flaring mouth and narrow neck. Painted in black over dull-red with horizontal bands on the shoulder. From early level *Variant 237a,* with a ribbed shoulder. From early level.

Type 238. Jar of medium fabric with flaring rim and globular body. Bichrome slips applied over buff wash on the shoulder and red above. Painted in crimson over buff with a hatched circle on the shoulder and over red with oblique strokes on the rim. From late level. *Variant 238a,* with a ribbed shoulder. Red slip applied enclosing white block on the shoulder. From surface.

Type 239. Miniature jar of thin fabric with a constricted neck and globular body. From late level. *Variant 229a,* with a flaring rim. From late level.

Type 240. Bottom of a bowl, of medium fabric with a ring-footed base. Red slip applied over a buff wash. From late level.

Type 241. Goblet of thin fabric with an ovoid body and pointed base. Chocolate slip applied. From early level. *Variant 241,* with a broad base. Red slip applied. From middle level.

Fig. 81

Type 242. Large dish-on-stand of thick fabric with a beaded base and a hole in the dish. Painted with black concentric bands on the interior of dish and horizontal bands enclosing loops and cross-hatched designs on the exterior. From middle level. Pl. CLXXV C. *Variant 242a,* with no hole in the centre. Painted in black over red with horizontal bands on the stem. From middle level Pl. CLXXV D, *1. Variant 242b,* of medium fabric. From middle level

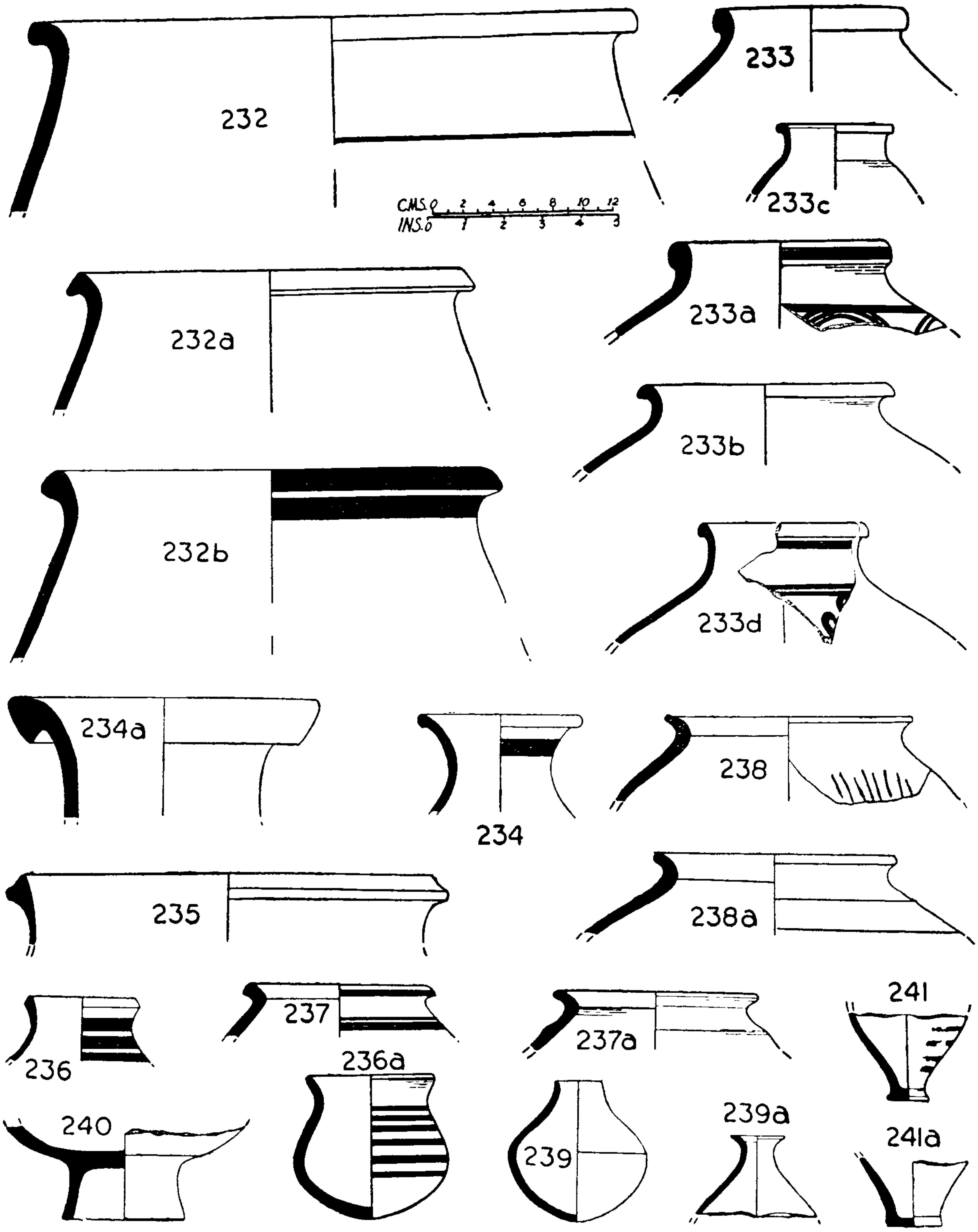

Fig. 80. *Red Ware, Period B, Types 232 to 241a*

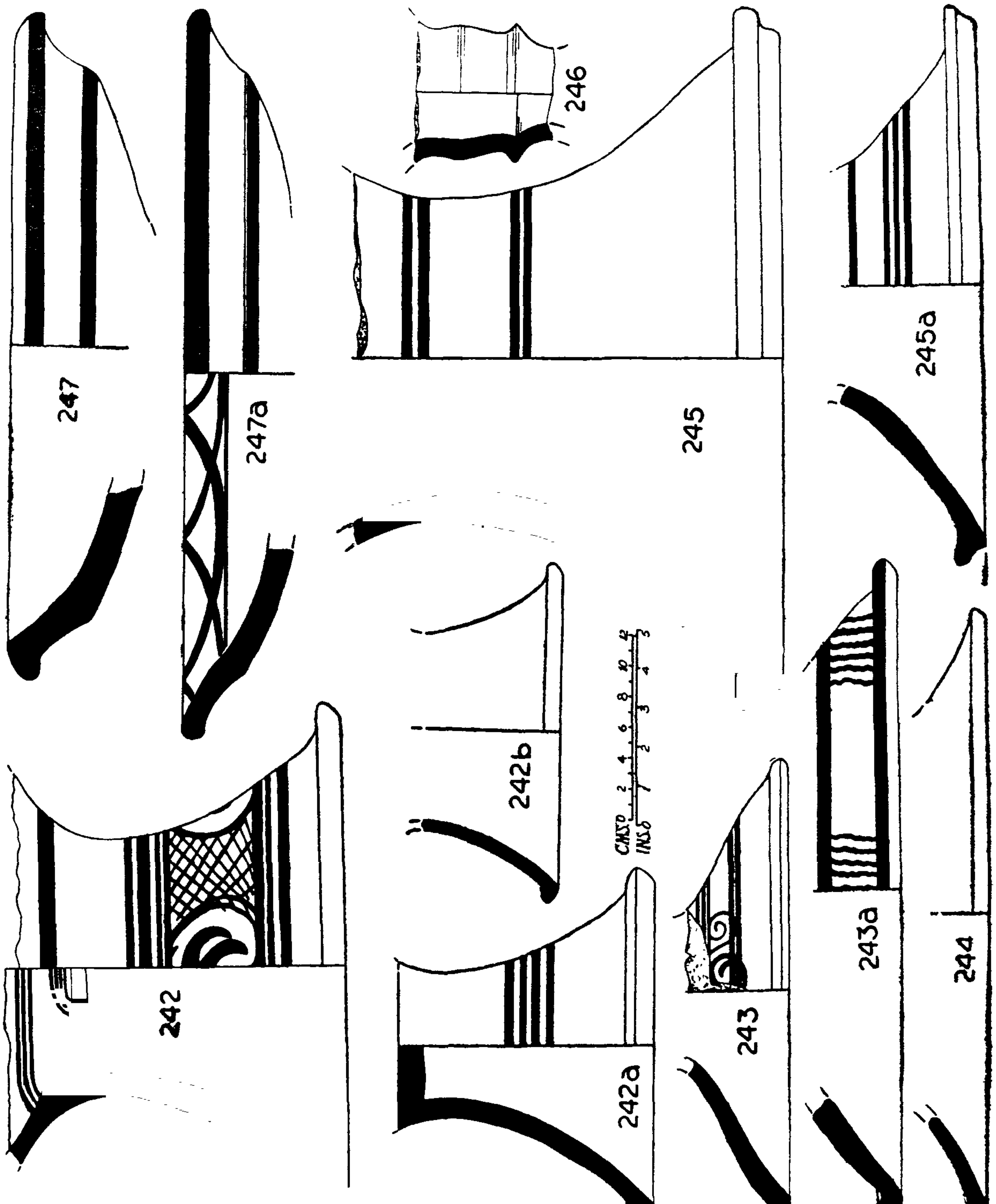

FIG. 81. *Red Ware, Period B, Types 242 to 247*

Type 243. Stem of dish-on-stand of medium fabric with a blunt base. Painted in black over red with horizontal bands enclosing loops on the exterior. From early level. *Variant 243a,* with a beaded base. Painted with black vertical wavy lines between horizontal bands. From late level.

Type 244. Stem of dish-on-stand of medium fabric with a broad beaded base. From middle level.

Type 245. Large stem of thick fabric with a concave sides and flanged base. Red slip applied partially over a buff wash. Painted with black horizontal bands on the exterior. From early level. Pl. CLXXVD, *2*. *Variant 245a,* painted in black over red with horizontal bands on the exterior. From middle level.

Type 246. Stem of dish-on-stand of medium fabric with a ball moulding and prominent ridge. From early level.

Type 247. Dish of thick fabric with a projected rim and carinated shoulder. Painted with black horizontal bands enclosing loops on the rim and a horizontal band on the shoulder. From late level. *Variant 247a,* of medium fabric with a splayed rim. Painted with black intersecting loops between horizontal bands on the rim and a band on the shoulder. From middle level. Pl. CLXXVI A. *1.*

Fig. 82

Type 248. Dish of medium fabric with a splayed rim and blunt carinated shoulder. From middle level. *Variant 248a,* with a thick rim. Painted with black concentric bands and wavy lines on the interior, horizontal bands enclosing intersecting loops on the rim and horizontal bands on the exterior. From late level. Pl. CLXXVI A, *2*. *Variant 248b,* with a thick blunt rim and carinated shoulder. From middle level. *Variant 248c,* painted with black loops on the rim and horizontal bands on the interior. From middle level. Pl. CLXXVI A, *3*. *Variant 248d,* with a thick everted rim. Painted with black oblique strokes and a horizontal band on the rim and shoulder, wavy lines enclosing a horizontal band on the iterior. From surface. *Variant 248e,* with a splayed rim. From middle level. *Variant 248f,* with a splayed rim and blunt carinated shoulder. From middle level. *Variant 248g,* with a short rim and ribbed shoulder. From middle level. *Variant 248h,* no carinated shoulder. From early level. CLXXVIA, *4*.

Type 249. Dish of medium fabric with a splayed rim, carinated shoulder and ledged interior. From middle level.

Type 250. Dish of thin fabric with an incurved rim. From middle level.

Type 251. Basin of medium fabric with an excurved projected rim and blunt carinated shoulder. From early level.

Type 252. Basin of medium fabric with a flat projected rim and bulbous body. Painted in black over red with horizontal bands on the shoulder. From surface. *Variant 252a,* with a beaked rim. Painted with black horizontal bands on the shoulder and horizontal bands enclosing loops on the rim. From late level. *Variant 252b,* with a hammer-headed rim. From late level.

Type 253. Small basin or bowl (?) of medium fabric with a flaring beaked rim and blunt carinated shoulder. Painted in black over red with horizontal bands on the rim and shoulder. From middle level. *Variant 253a,* of thin fabric. Painted with oblique strokes and a horizontal band on the rim and vertical wavy lines below a horizontal band on the shoulder. From middle level.

Type 254. Small bowl of thin fabric with a flaring rim and blunt carinated shoulder. Perhaps it had a a stem as in the case of Rangpur bowls. From middle level.

Type 255. Bowl of medium fabric with an averted rim and bulbous body. Painted in black over dull-red with horizontal bands on the shoulder. From early level.

Fig. 83

Type 256. Bowl of medium fabric with a featureless rim and convex sides. Coarse Fabric. From early level. *Variant 256a,* with a thick blunt rim. Brown slip applied on the exterior with paring marks. From late level. *Variant 256b,* with a slightly everted rim and blunt carinated shoulder. From late level.

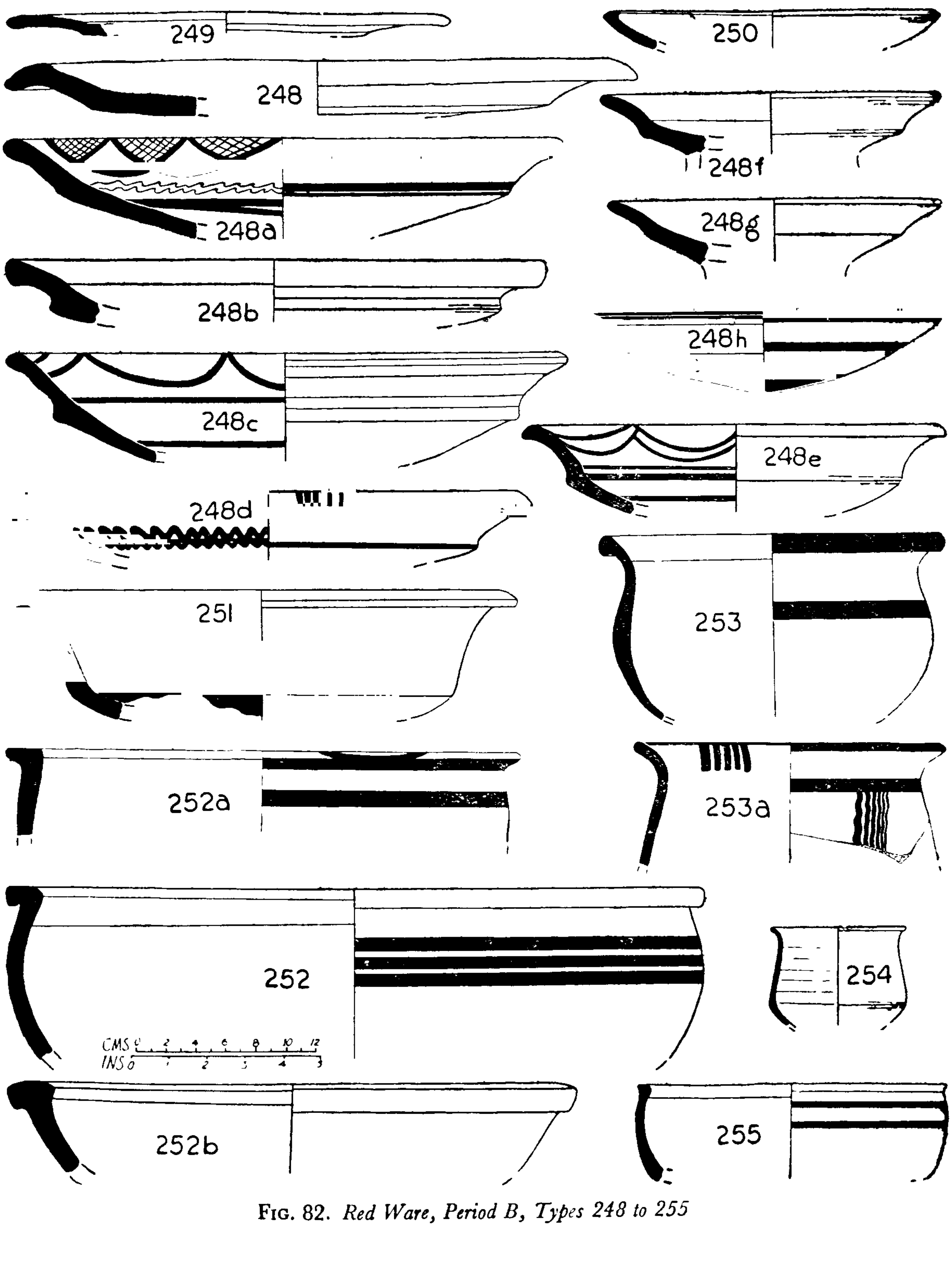

FIG. 82. *Red Ware, Period B, Types 248 to 255*

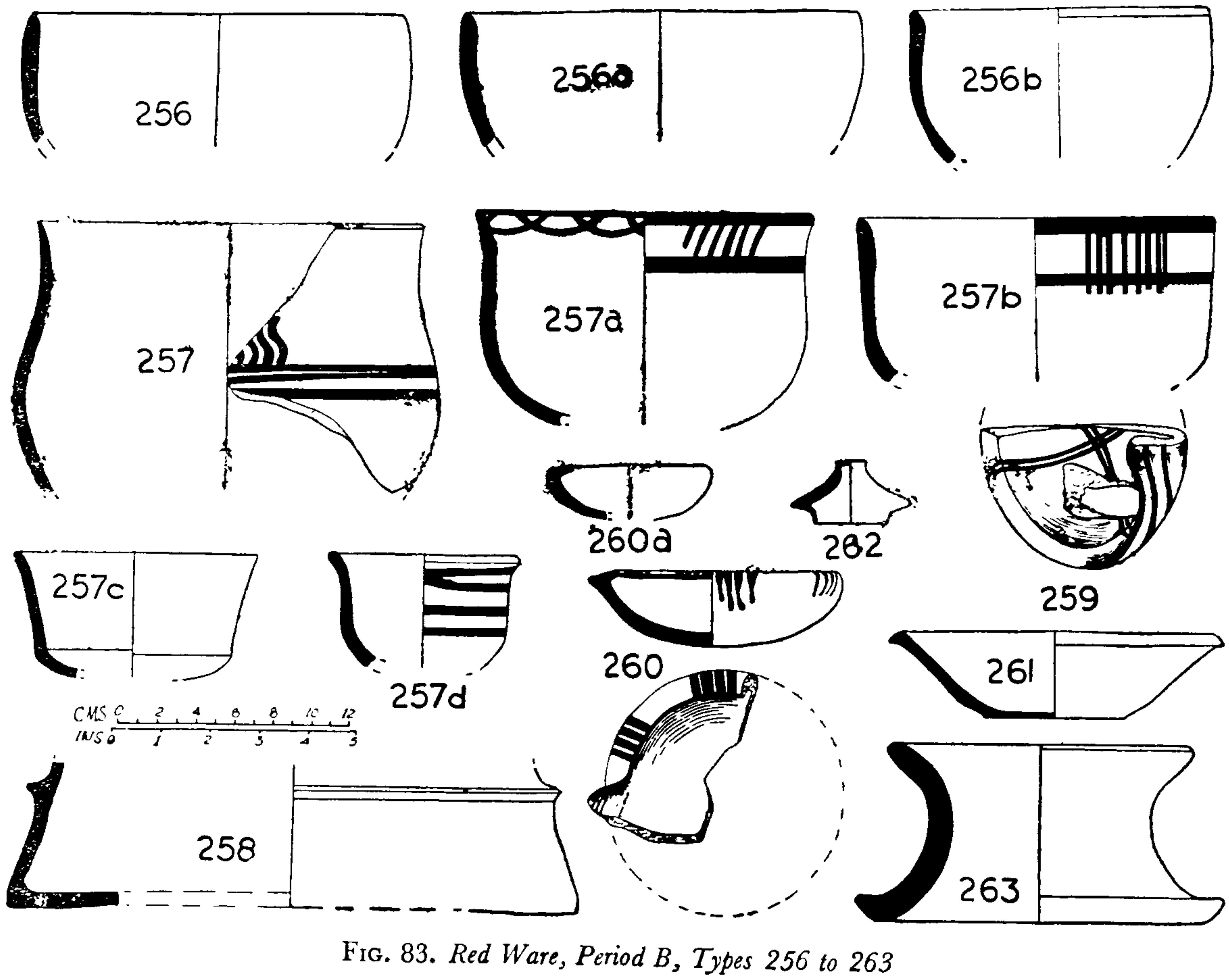

FIG. 83. *Red Ware, Period B, Types 256 to 263*

Type 256. Bowl of thin fabric with a flaring featureless rim, concavo-convex profile and blunt carinated shoulder. Painted with black vertical wavy lines between horizontal bands on the exterior. From middle level. *Variant 257a,* with an everted rim. Painted with intersecting loops below a band on the rim. From middle level. *Variant 257b,* with straight sides. From middle level. *Variant 257c,* with flaring sides and sharp carinated shoulder. From middle level. *Variant 257d,* painted in black over red with horizontal bands on the exterior. From middle level.

Type 258. Casket of medium fabric with slightly-incurved flanged sides and concave base. From early level.

Type 259. Lamp of medium fabric with an obliquely-cut rim, pinched lip, sagger base and provision for wick. Painted with black horizontal bands on the exterior and vertical intersecting lines on the interior. From middle level. Pl. CLXXVI B, *1.*

Type 260. Lamp of medium fabric with an incurved rim, pinched lip and sagger base. Painted with black oblique strokes below a horizontal band on the rim. From early level. Pl. CLXXVIB, *2. Variant 260a,* with a flat incurved rim. From middle level.

Type 261. Lid of thin fabric with an everted rim, tapering sides and flat base. From early level.

Type 262. Small lid of thin fabric with a flanged base and internally hollow knob. From middle level.

Type 263. Ring-stand of medium fabric with a beaded base. From early level.

(ii) *Buff-slipped Ware*

This is a red ware treated with a buff slip but coarser in fabric and occurs in a small quantity in Period B. The evolution in forms corresponding to the one noticed in the red ware is apparent in the buff-slipped ware also.

Fig. 84

Type 264. Large storage jar of thick fabric with a flat projected rim and bulbous body. From early level. *Variant 264a,* with a short rim. From middle level.

Type 265. Large storage jar of medium fabric with a flat projected rim, narrow mouth, ledged shoulder and globular body. Red slip partially applied over buff wash above the shoulder. Painted in black over red with horizontal bands on the shoulder and alternate cross-hatched blocks below the buff. From surface.

Type 266. Large storage jar of thick fabric with a beaded rim and globular body. From middle level. *Variant 266a,* slight difference in shape. From late level. *Variant 266b,* with a ledged shoulder. From middle level. *Variant 266c,* with a beaked rim. Red slip applied over a buff background above the shoulder. Painted in black over red with horizontal bands enclosing zigzag lines on the shoulder and over a buff surface with a loop below the shoulder. From early level.

Type 267. Perforated jar of medium fabric with a thick projected rim. From early level.

Type 268. Jar of medium fabric with a beaded rim, raised neck, globular body and disk base. Buff slip applied on the exterior almost flaked off. From middle level. *Variant 268a,* painted in chocolate over buff with horizontal bands on the rim and shoulder. From middle level. *Variant 268b,* with a short neck. From early level.

Type 269. Jar of medium fabric with a flaring rim and globular body. Chocolate slip partially applied over a greenish buff surface on the shoulder and rim. Painted in light crimson over a buff with horizontal band enclosing oblique strokes. From early level.

Fig. 85

Type 270. Squattish stem of dish-on-stand of medium fabric with a beaded base. Buff slip applied on both surfaces. From early level. *Variant 270a,* with a broad base and grooved interior. From middle level.

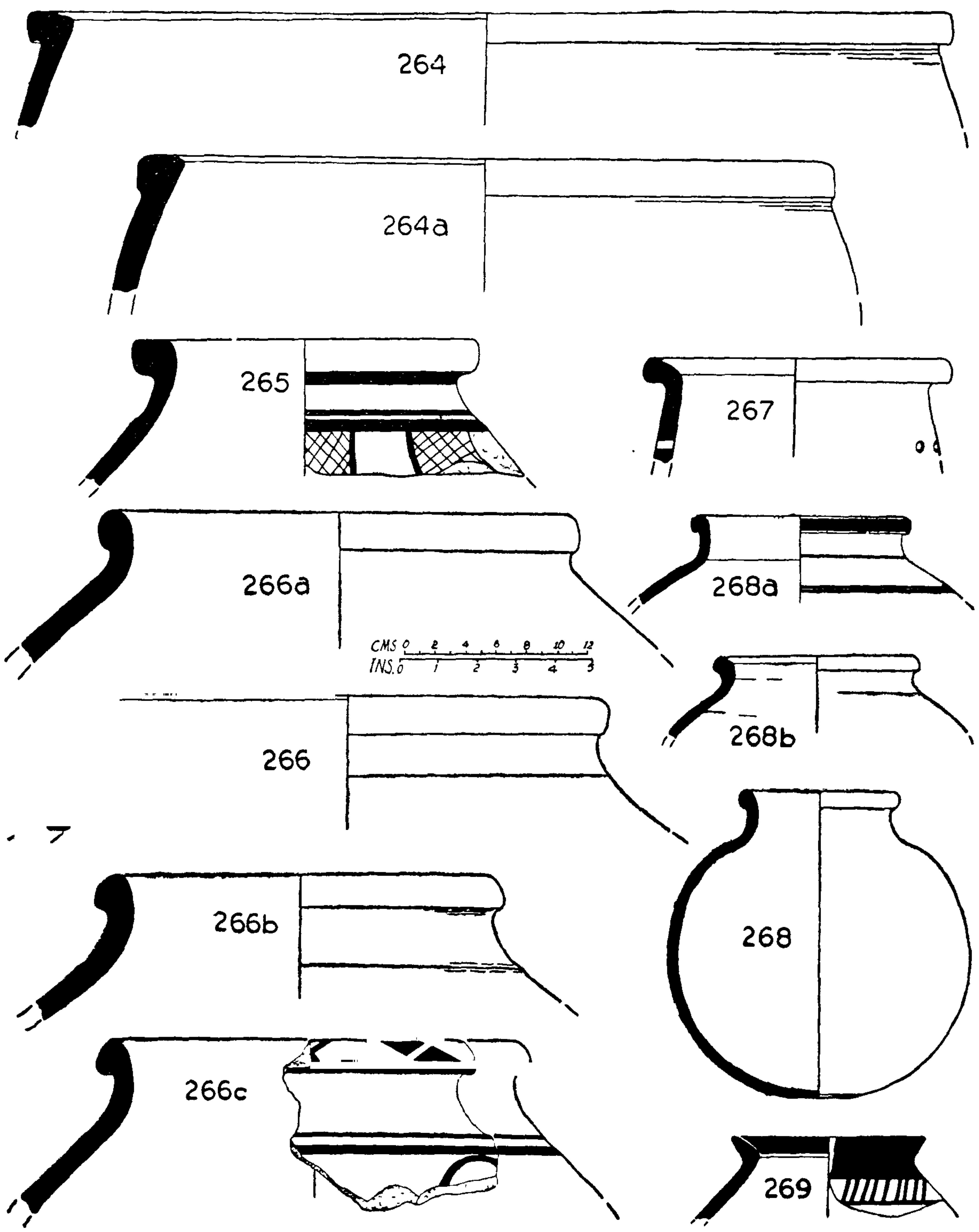

FIG. 84. *Buff-slipp.d Ware, Period B, Types 264-269*

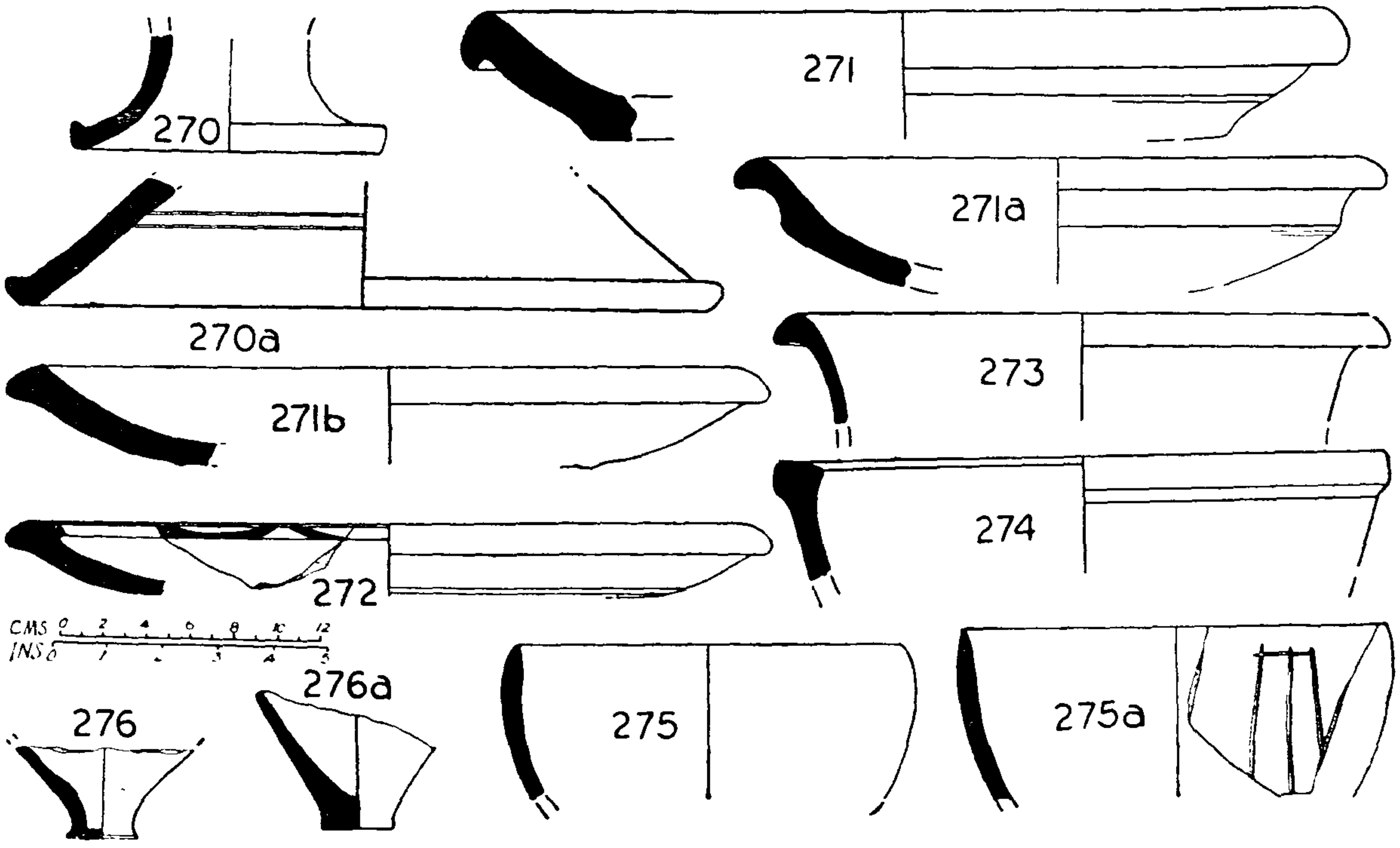

FIG. 85. *Buff-slipped Ware, Period B, Types 270-276a*

Type 271. Dish of thick fabric with an excurved rim and carinated shoulder. Red slip applied on the interior and buff on the exterior. From early level. *Variant 271a,* with excurved and sharp carinated shoulder. Chocolate slip almost flaked off. From middle level. *Variant 271b,* with a thick ring. From surface.

Type 272. Dish of medium fabric with an expanded rim. Painted in black over light-brown with loops between horizontal bands on the rim and a band below. From middle level.

Type 273. Basin of medium fabric with an excurved rim and slightly concave sides. Greenish buff applied. From late level.

Type 274. Basin of medium fabric with a flat clubbed rim and convex sides. From middle level.

Type 275. Bowl of thin fabric with a featureless rim and bulbous body. From middle level. *Variant 275a,* of greenish fabric. Green slip applied. Graffiti marks on the exterior visible. From late level.

Type 276. Goblet of thin fabric with a pointed base. From middle level. *Variant 276a,* with a base of different shape. Light chocolate slip applied on the exterior. From early level.

B. Associated Wares

(i) *Micaceous Red Ware*

The Micaceous Red Ware occurs in considerable quantity along with the Red Ware. The transformation of shapes is more gradual in this ware than in the Harappa wares which may be due to the conservatism of the Micaceous Red Ware-using folk. The main types are the bowl with a long stud-handle, the globular or ovoid jar with a flaring mouth and the bowl with convex sides or carinated shoulder. The original convex sided bowl of Period A is now evolved into a carinated one and the stud-handle is also elongated in Period B. The fabric and treatment of surface have also deteriorated. Painting however continued to be executed in black over a light-red or dull-orange surface. Mostly geometrical and linear designs such as the criss-cross, hatched diamond and triangle, horizontal bands and wavy lines are painted. Vegetable motives such as the wheat plant etc., are occasionally depicted.

Fig. 86

Type 277. Jar of medium fabric with a flaring rim and globular body. Painted in black over light-red with horizontal bands on the neck. From early level. *Variant 277a,* with an everted rim. Not painted. From middle level. *Variant 277b,* with a long flaring rim and ovoid body. Painted with black horizontal bands enclosing oblique strokes on the shoulder and overlapped by a horizontal band in the centre From early level *Variant 277c,* a pear-shaped jar. From middle level.

Type 278. Small bowl of medium fabric with a flaring rim and bulbous body. Painted with black loops below a horizontal band on the rim and horizontal bands enclosing a wavy line overlapping a horizontal band in the centre. From middle level. *Variant 278a,* with a short everted rim. Painted in black over light-red with horizontal bands on the neck and intersecting oblique and vertical bands on the interior. From middle level.

Type 279. Bowl of medium fabric with a featureless rim and bulbous body. Painted with black horizontal bands on the rim. From late level. *Variant 279a,* painted in black over red with horizontal bands enclosing a wavy line on the rim and intersecting vertical bands on the interior. From surface. *Variant 279b,* of small size. From early level.

Type 280. Bowl of medium fabric with elongated stud handle and bulbous body. Painted in black over light-red with horizontal bands enclosing a wavy line on the exterior, a wavy line below a horizontal line on the interior and a cross on the stud. From late level. Pl. CLXXVII A, *1. Variant 280a,* with a small stud handle. From surface Pl. CLXXVII A, *2.*

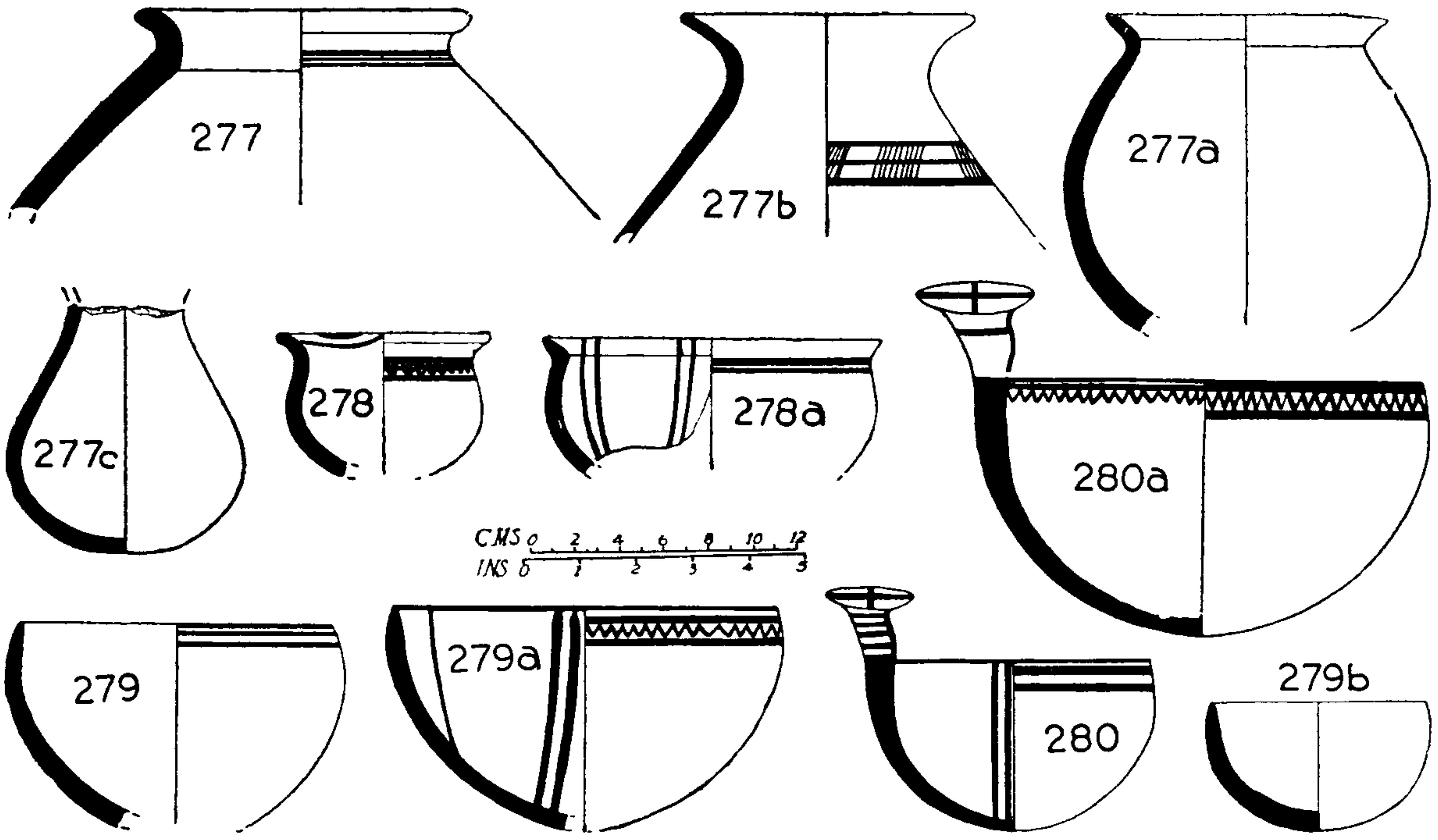

FIG. 86. *Micaceous Red Ware, Period B, Types 277-280a*

(ii) *Coarse red ware*

The coarse red ware is more gritty in fabric, owing to the use of a greater quantity of grit than in other wares and due to imperfect firing. The vessels break easily, and the surface is rough. Decoration consists of incised designs such as horizontal or way lines, oblique slashes, notches etc. The main ceramic types are the globular jar, dough plate etc. It is interesting to note that the flaring rim noticed in Period A has developed into an acute angular rim in Period B.

Fig. 87

Type 281. Jar of medium fabric with a flaring rim and globular body. Incised nail-tip pattern over a slightly-raised band on the shoulder. From early level. *Variant 281a,* with a long projected rim. Devoid of decorations. From late level. *Variant 281b,* with a wide mouth. Rows of incised notches on the shoulder. From middle level. *Variant 281c,* with a ribbed shoulder. From late level.

Type 282. Shallow dish of medium fabric with an expanded rim. From early level.

Type 283. Bowl or lid (?) of medium fabric with a flanged rim and narrow flat base. From middle level.

Type 284. Lid of medium fabric with a flat base and solid knob. Hand made. From surface.

Type 285. Jar of medium fabric with flaring rim, globular body and ribbed shoulder. From late level.

(ii) *Coarse grey ware.*

This ware is identical with the coarse red ware both in shape and fabric. The surface of the vessels is black to grey in colour on account of firing under reducing conditions or perhaps due to the use of carbonaceous matter.

C. Prabhas Ware

This ware named after the first site of its occurrence is mossy grey in colour painted in pinkish over a brownish slip with vertical flowing wavy lines in groups. The only type found in Period B at Lothal is the bowl with bevelled rim and perhaps a round bottom (pl. CLXXXIVA 15-16). At Prabhas other designs such as oblique and vertical lines in groups and the ball-and-stem motif are also painted. The Prabhas Ware is said to occur at Rojdi in a context earlier than it does at Prabhas.

D. Painted Sherds

Fig. 88

B1. Sherd painted in black over reddish brown on the exterior with a stylised peacock motif, the plumes being indicated by a few strokes. Body filled and neck long. Details lacking. Example of degeneration in executing Harappan motifs. Red Ware of medium fabric. From phase VA. Pl. CLXXVII B, *1.* Similar motifs occur in Harappan pottery in the Indus Valley.

B2. Sherd painted in black over red on the exterior with two birds over a horizontal band, one perhaps chasing the other, the bird in the rear having long legs and neck. The one in front has partially open plumes and filled body. Example of stylisation of bird motif. Red Ware of thick fabric. From phase VA. CLXXVII B, *2.* Stylised bird occurs at Alamgirpur also.[1]

[1] *Indian Archaeology,* 1958-59, *A Review,* pl. LXIV.

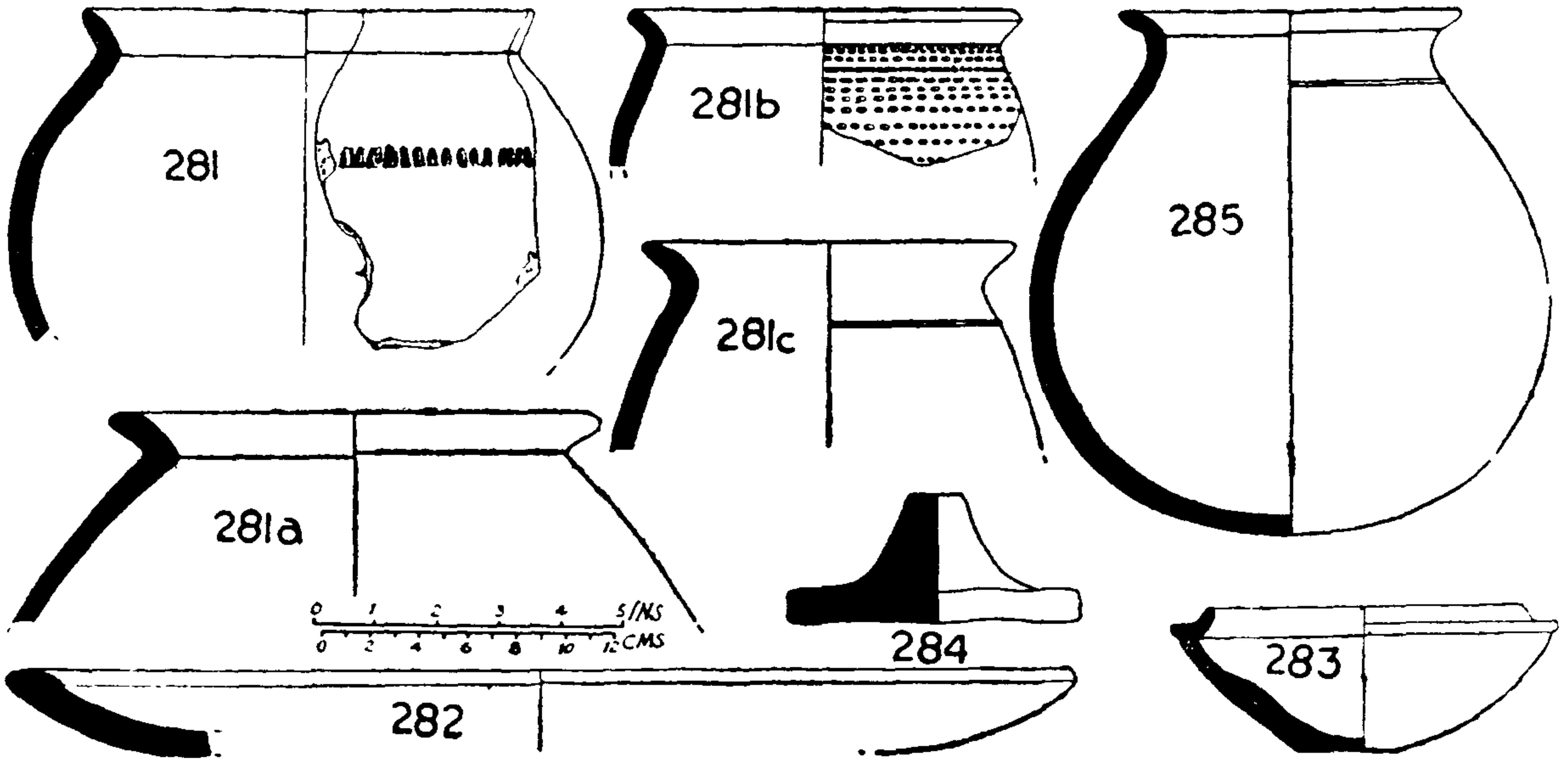

FIG. 87. *Coarse red ware, Period B. Types 281-283*

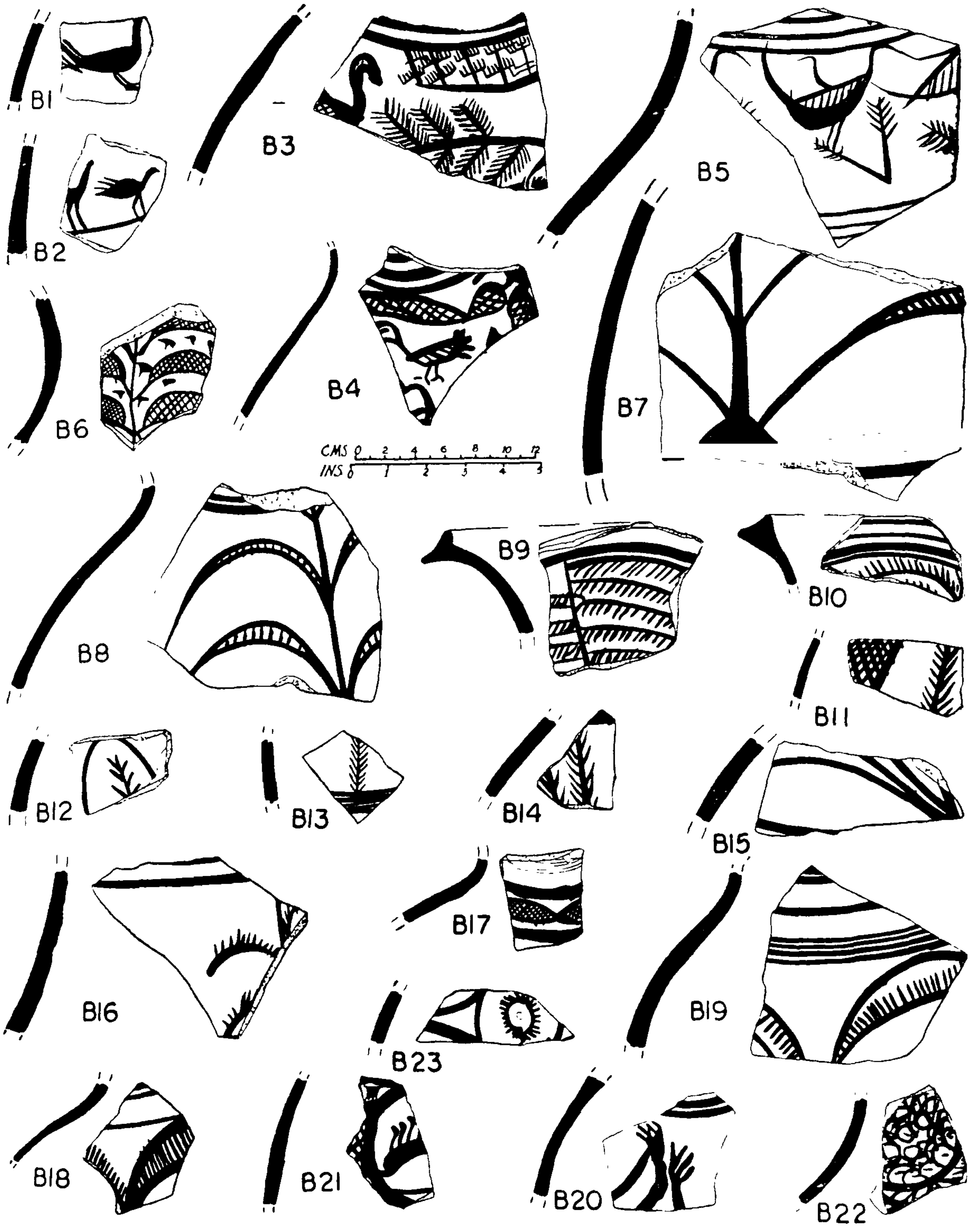

FIG. 88. *Painted sherds, Period B, B1 to B23*

B3. Sherd painted in black over red on the exterior with a bird resembling a duck or a swan in front of which a branch of a tree is also depicted horizontally. A row of stylised plants enclosed between horizontal bands suggesting plants in marshy land also drawn. Red Ware of thick tabric. From phase VA. Pl. CLXXVIIC *1.* Occurs at Harappa also.

B4. Sherd painted in black over red on the exterior with a bird similar to a fowl with plumed tail, hatched body and a large head. Cross-hatched florid design and horizontal bands noticed above and a few indistinct motifs below. A leaf design behind the bird. Micaceous Red Ware of medium fabric. From phase VA. Pl. CLXXVIIC *2.* Occurs at Harappan and Mohenjo-daro.

B5. Sherd painted in black over red on the exterior with two highly stylised birds one of which is fully visible and the other partially, former holding a fish and perching on a branch. Neck and head indicated by curvilinear motifs. The tail and partially open wings suggest bird about to fly away. Body of the bird and fish hatched. Red Ware of medium fabric. From phase VA. Pl. CLXXVII D. Occurs in the Diyala region also[1].

B6. Sherd painted in black over red on the exterior with a plant motif, the interspace between the palm leaves being used for depicting flying birds in a stylised form. Red Ware of medium fabric. From phase VA. Example of Harappan motif and style in Period B. Pl. CLXXVII D, *2.*

B7. Sherd painted in black over red on the exterior with a tree having apposite arrangement of branches and hatched leaf akin to the palm variety. Two horizontal bands seen below. Red Ware of medium fabric with a rough surface. From phase VA. Pl. CLXXIX A, *1.* Occurs at Harappa.

B8. Sherd painted in black over red on the exterior with a tree having opposite arrangement of long hatched leaves. Two horizontal bands seen above. Red Ware of medium fabric with rough surface. From phase VA. Pl. CLXXIX A, *2.*

B9. Sherd painted in black over red on the exterior with a tree having alternate arrangement of branches, the leaves being indicated by oblique strokes. Red Ware of medium fabric. From phase VA. An example of Harappan motif and style in Period B.

B10. Sherd painted in black over red on the exterior with a tree only one branch of which is visible, leaves being indicated by strokes. Horizontal bands seen above the branch. Red Ware of medium fabric. From phase VA.

B11. Sherd painted in black over red on the exterior with a motif similar to the wheat plant as indicated by the blades. Also a cross-hatched panel visible on one margin. Red Ware of thin fabric. From phase VA. Motif common on Micaceous Red Ware in Period A.

B12. Sherd painted in black over red on the exterior with a plant motif enclosed in an arch. Red Ware of medium fabric. From phase VA. Occurs in Period A. Harappan style of painting.

B13. Sherd painted in black over light red on the exterior with a delicate plant rising above a series of horizontal bands. A good example of delicate brush work. Micaceous Red Ware of medium fabric. From phase VA.

B14. Sherd painted in black over light red on the exterior with two wheat plants one by the side of the other. Micaceous Red Ware of medium fabric. From phase VA. Occurs in Period A also.

B15. Sherd painted in black over a greenish slip on the exterior with pointed leaf pattern by joining arcs. A horizontal band also visible in one corner. Green ware of medium fabric. From phase VA. Occurs at Prabhas also.[2]

B16. Sherd painted in black over a buff slip on the exterior leaves indicated by strokes along arcs Horizontal bands at the top. Red Ware of medium fabric. From phase VA. Occurs in Alamgirpur.[3]

B17. Sherd painted in black over light red on the exterior with a row of cross hatched leaves or lozenges

[1] Pinhas Delougaz *op. cit.* pl. 15.

[2] *Indian Archaeology* 1956-57 *A Review*, pl. XVII.

[3] *Ibid.* 1958-59, fig. 24.

and enclosed between horizontal bands. Micaceous Red Ware of medium fabric. From phase VA. Occurs in Jhukar levels Chanhu-daro[1] and Bara.[2]

B18. Sherd painted in red on buff and red slips on the exterior with two pointed and hatched leaves From phase VA. An example of Harappan motif continuing in Period B.

B19. Sherd painted in black over separate zones of greenish and chocolate slips on the exterior with pointed and hatched leaves formed by joining arcs. Groups of horizontal. band seen above. Greenish ware of medium fabric. From phase VA. Occurs in Jhukar levels of Chanhu-daro.[3]

B20. Sherd painted in black over light red on the exterior with arcs meeting at a plumed point as also a vertical line with a plume, perhaps suggesting plants. Two horizontal bands above. Red ware of medium fabric. From phase VA.

B21. Sherd painted in black over red on the exterior with a loop enclosing an indeterminate object strokes coring from above cross-hatching outside the loop also visible. Red Ware of medium fabric. From phase V B.

B22. Sherd painted in black over red on the exterior with a series of loops with strokes more or less resembling bee-hive. Perhaps enclosed in a circle. Red Ware of medium fabric. From phase VA. Occurs in Harappa and Mohenjo-daro also.

B23. Sherd painted in black over red on the exterior with a rayed circle and a dot enclosed in a larger circle which is partially visible. Two other arcs touch the circle. Red Ware of coarse fabric from phase VA.

Fig. 89

B24. Sherd painted in black over red on the exterior with a plumed loop drawn in double lines and enclosed between multiple horizontal bands; zigzag line occurs between these bands. Micaceous Red Ware of medium fabric. From phase VB. Occurs in Rangpur IIC also.

B25. Sherd painted in black over orange red on the exterior with plumed loops running in opposite directions the interspace being cross-hatched; groups of oblique lines enclosed between horizontal bands above the loops. Micaceous Red Ware of medium fabric. From phase VA.

B26. Sherd painted in black over a bright red slip on the exterior with labyrinth. Micaceous Red Ware of thin fabric. From phase VA. Occurs in Rangpur III and Jhukar levels of Chanhu-daro.

B27. Sherd painted in red over a buffish slip on the exterior with intersecting loops or arcs springing from a point and enclosed between horizontal bands. Buff-slipped ware of medium fabric. From phase VB.

B28. Sherd painted in black over light red on the exterior with two oblique rows of highly stylised birds almost resembling the sign of sigma. Micaceous Red Ware of medium fabric. From phase VA. Pl. CL-XXVIII 1. Motif occurs in the Indus Valley also.

B29. Sherd painted in black over red on the exterior with vertical strokes on the horizontal lines joined by a vertical one. Red ware of coarse fabric. From phase VA. Pl. CLXXVIII *2.*

B30. Sherd painted in black over red on the exterior with derivative leaf patterns by hatching the interspace between intersecting arcs and semi-cricles. Two horizontal rows of alternately filled triangles and a zigzag line between horizontal bands seen. Leaf patterns and filled triangles enclosed by horizontal bands. Red ware of medium fabric. From phase VA Pl. CLXXVIII, *3.*

B31. Sherd painted in black over orange red slip on the exterior with horizontal bands enclosing inverted loops in series. Double suspended loops also noticed below. Micaceous Red Ware of medium fabric. From phase VA. Pl. CLXXVIII *4.*

B32. Sherd painted in black over red on the exterior with zigzag line between horizontal bands below which a wavy line is again enclosed by bands. Micaceous Red Ware of medium fabric. From early level. Pl. CLXXVIII, *5.*

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[1] Mackay *op. cit* 1943 pl. XLVII.

[2] *Indian Archaeology* 1956-57 *A Review.*

[3] Mackay, *op. cit.* 1943. pl. XLVII.

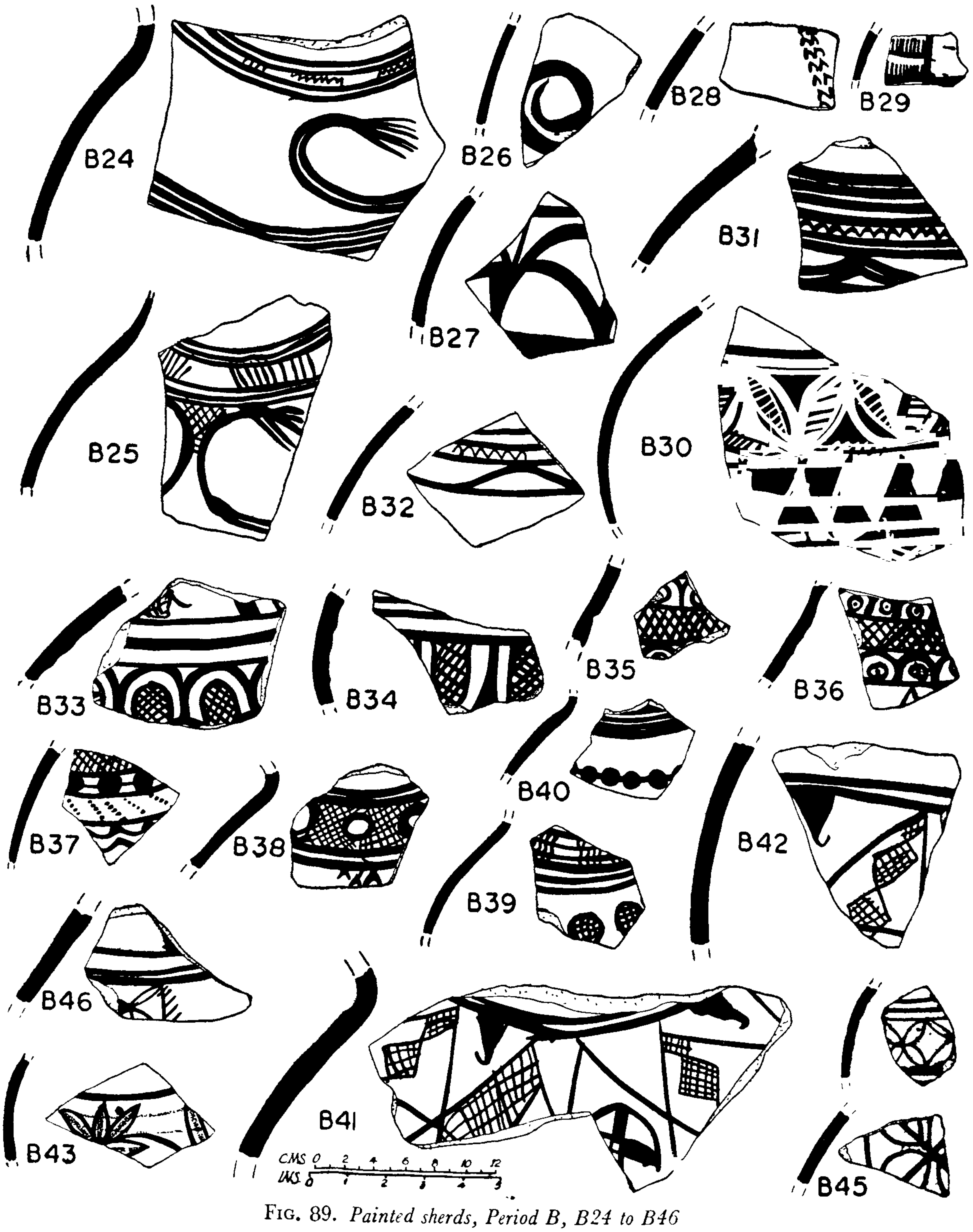

FIG. 89. *Painted sherds, Period B, B24 to B46*

B33. Sherd painted black over red on the exterior with cross hatched ovals enclosed between arches below horizontal bands. A hatched triangle or oval shaped design visible partially above. Red Ware of medium fabric. From phase V*a*. A good example of characteristic Harappan style surviving in Period B.

B34. Same as above except for the hatched design above the bands. From phase VB.

B35 and *B36.* Sherd painted in black over red on the exterior with a hatched panel in the centre and a series of semi-circles enclosing circles and dots both above and below the hatched panel. Red Ware of medium fabric. From phase VA. Another example of typical Harappan design in Period B.

B37. Sherd painted in black over red on the exterior with a row of pellets enclosed between horizontal bands and a series of dots running in oblique rows. The upper panel cross hatched and the lowest painted with two wavy lines. Red ware of coarse fabric. From phase VA. These designs occur individually in Rangpur IIC.

B38. Sherd painted in black over red on the exterior with a cross-hatched panel enclosed by horizontal bands. Blank circles at regular intervals in the hatching and strokes resembling inverted 'V's noticed below. Micaceous Red Ware of medium fabric from phase VA.

B39. Sherd painted in black over red on the exterior with a row of hatched circles below horizontal bands between which groups of small arcs are drawn. Micaceous Red Ware of medium fabric. From phase VA.

B40. Sherd painted in purplish brown over buff on the exterior with a row of pellets over a horizontal band. A group of horizontal bands enclosing inverted loops seen above. Buff ware of medium fabric. From phase V*a*.

B41 and *B42.* Sherds painted in black over red with vertical rows of hatched diamonds, floral pattern enclosed in a circle and hatched rectangles between intersecting oblique lines dividing the vessel surface into large triangular compartments. Filled triangle with hook drawn at intervals along thick horizontal bands. Red ware with a coarse smoky section. Phase VA. Pl. CLXXIX B.

B43. Sherd painted in red and black over a buffish background on the exterior with a floral design, petals being formed by joining arcs in black and the mid-rib indicated by a line in red. Two slips namely red in the upper one-third and buff in the lower two-thirds, applied. Bichrome ware of medium fabric. From phase *Va*. An example of survival of the bichrome ware and the design occurs in Jhukar levels of Chanhu-daro.

B44. Sherd painted in black over red on the exterior with a row of four-petalled flowers by joining the intersecting arcs between horizontal bands. Red Ware of medium fabric. From phase VA. Typical Harappan style in Period B. Occurs in the Indus Valley sites.

B45. Sherd painted in black over red on the exterior with a conventional floral design by adding arcs to the intersecting lines which form the midribs of the four-petalled flower. Red Ware of medium fabric. From Phase VB. Example of Harappan style found in Period B. Occurs at the Indus Valley sites.

B46. Sherd painted in black over a dark red slip on the exterior with a four-petalled flower (as in B44) and a plant motif vaguely indicated by oblique strokes on a vertical band. Above the floral pattern are horizontal bands. Red Ware of medium fabric. From phase VB. Example of Harappan style in Period B.

Fig. 90

B47. Sherd painted in black on red and buff slips on the exterior with groups of vertical lines and wavy lines alternately between horizontal bands. Further below are three horizontal bands in a group. Red ware of coarse fabric. From phase VB. Occurs in Prabhas also.

B48. Sherd painted in black over red on the exterior with a thick horizontal band on the rim and several thin ones further below.

B49. Sherd painted in black over red on the exterior with vertical lines between horizontal bands; other fragmentary motifs below are not clear. Red ware of coarse fabric from phase VB.

B50. Sherd painted in purplish brown over light red on the exterior with vertical strokes between horizontal bands. Micaceous Red Ware of thin fabric. From phase VA.

B51. Sherd painted in black over light red on the exterior with groups of oblique lines between hori-

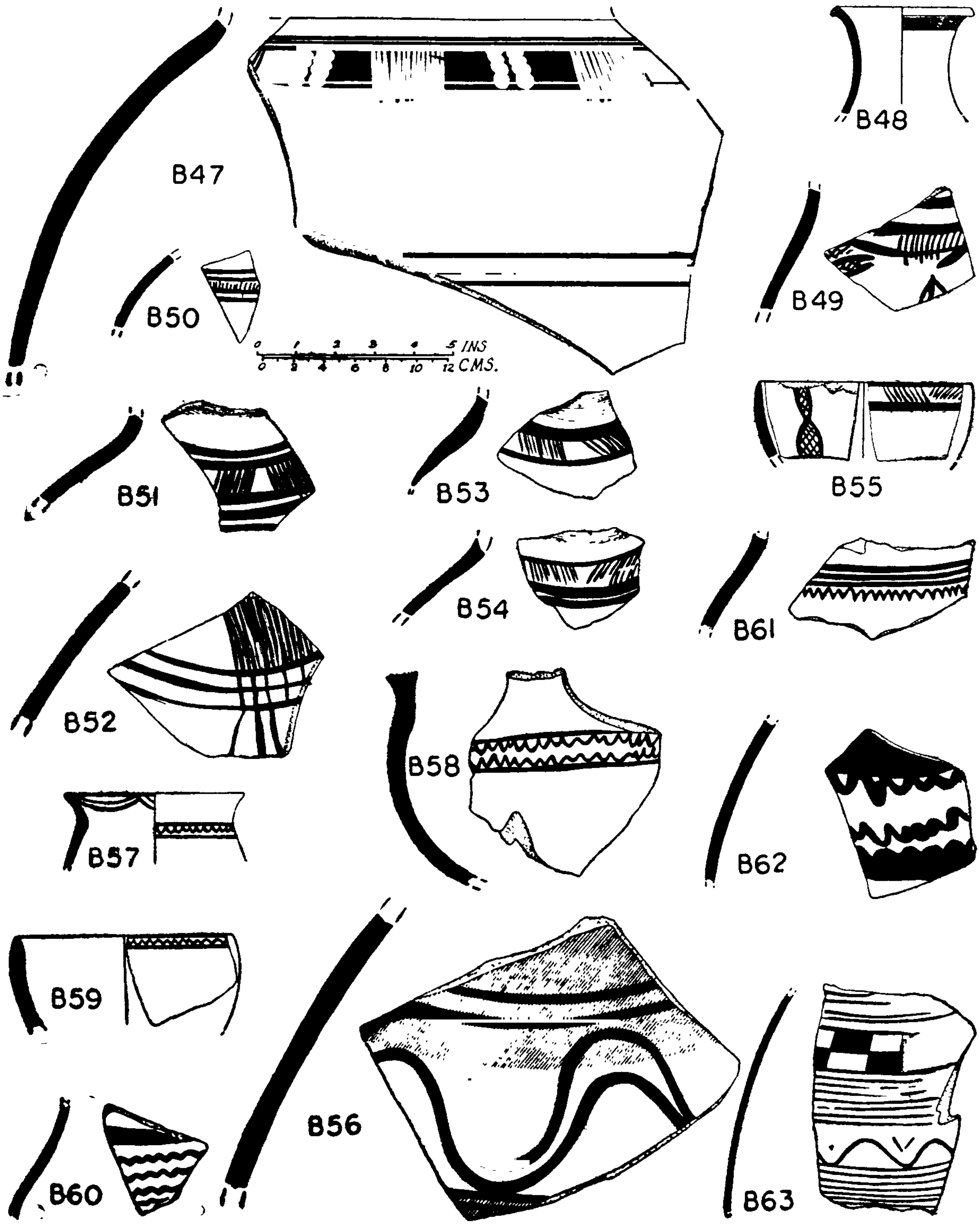

FIG. 90. *Painted sherds, Period B, B47 to B63*

zontal bads. Micaceous Red Ware of medium fabric. From phase VA. A popular design of Period B.

B52. Sherd painted in purplish brown over light red on the exterior with vertical lines above, below and across horizontal bands. Micaceous Red Ware of medium fabric. From phase VB. An example of indifferent painting.

B53. Sherd painted in black over orange red on the exterior with thin oblique lines in groups between horizontal bands. Micaceous Red Ware of medium fabric. From phase VA.

B54. Sherd painted in black over a light red micaceous slip on the exterior with groups of oblique lines between horizontal bands. Coarse Red Ware of medium fabric. From phase VA.

B55. Sherd painted in black over light red with groups of oblique strokes between horizontal bands. Micaceous Red Ware of medium fabric. From phase VA.

B56. Sherd painted in black over red and buff slips with horizontal running wavy lines, a symbol for water or river, enclosed between horizontal bands. Red ware of thick fabric. From phase VA. A popular motif in Period B. Occurs in the late levels of Mohenjo-daro,[1] in the Jhukar levels at Chanhu-daro.[2]

B57. Sherd painted in black over red on the exterior with continuously running loops enclosed between horizontal bands. Two loops in double lines painted on the interior below a horizontal band on the rim. Micaceous Red Ware of medium fabric. From phase VA. Design occurs on bowls and jars with flaring rim in Micaceous Red Ware in Period B.

B58. Fragment of a bowl with stud handle painted in black over red on the exterior with two wavy horizontal lines between horizontal bands. Micaceous Red Ware of medium fabric. From phase VA. Occurs in Harappa levels at Chanhu-daro.[3]

B59. Sherd painted in black over red on the exterior with a wavy line enclosed between horizontal bands. Micaceous Red Ware medium fabric. From phase VA.

B60. Sherd painted in deep black over deep red on the exterior with for thick wavy lines running horizontally below a horizontal band. Red Ware of medium fabric. From phase VA.

B61. Sherd painted in black over red on the exterior with a wavy line below three horizontal bands. Red Ware of medium fabric. From phase VB.

B62. Sherd painted in black over red on the exterior with three horizontal wavy lines. Thick and irregularly drawn between horizontal bands by means of finger instead of a brush. Red ware of coarse fabric. From phase VB. Pl. CLXXIXC. *1.*

B63. Sherd painted in black over red on the exterior with alternately filled rectangles in Harappan style between a series of horizontal bands. Also a thin wavy line enclosed between bands. Red Ware of thin fabric. From phase VA. An example of the combination of Harappan motif in an otherwise non-Harappan style. Pl. CLXXIX C. *2.*

Fig. 91

B64. Sherd painted in black over red on the exterior with wavy lines in groups of two above a horizontal band. Design simple and popular in Period B. Red Ware of medium fabric. From phase VA. Example of painting with a multiple brush. Pl. CLXXX, 1.

B65. Sherd painted in black over red on the exterior with flowing vertical wavylines enclosed between horizontal bands. Red ware of coarse fabric. From phase VB. Pl. CLXXX *2.* Occurs at Prabhas in Period I A.

B66. Sherd painted in black over red on the exterior with a group of vertical wavy lines perhaps between two loops above two horizontal bands. Red Ware of medium fabric. From phase VB. Pl. CLXXX, *3.*

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[1] Mackay *op. cit.* 1938 pl. LXVIII, *25.*

[2] Mackay *op. cit.* 1943, pl. XXXIV, *7.*

[3] *Ibid.* pl. XXXIV, *7.*

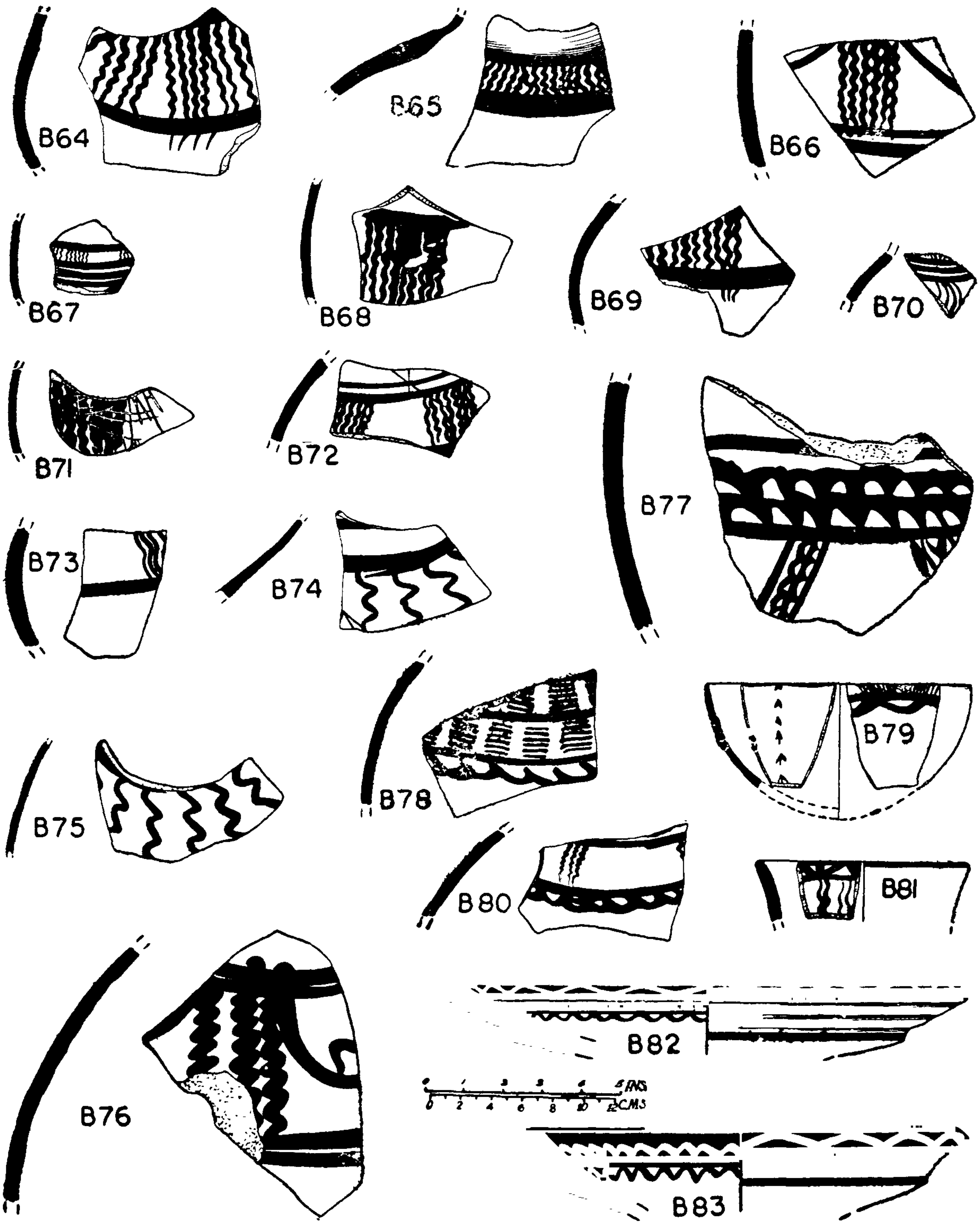

FIG. 91. *Painted sherds, Period B, B64 to B83*

B67. Sherd painted in black over red on the exterior with groups of thin vertical wavy lines between horizontal bands. Red Ware of medium fabric. From phase VA. Pl. CLXXX, *4*.

B68. Sherd painted in black over red on the exterior with vertical wavy lines in a group below a horizontal band. Multiple brush used. Red Ware of medium fabric. From phase VB. Pl. CLXXX, *5*.

B69. Sherd painted in black over red on the exterior with vertical wavy lines above a horizontal band. Some across also. Multiple brush used. Red Ware of medium fabric. From phase VA. Pl. CL2XX, *6*.

B70. Sherd painted in black over light red on the exterior with four arcs below horizontal bands. Micaceous Red Ware of medium fabric. From phase VA. Pl. CLXXX, *7*.

B71. Sherd painted in black over red on the exterior with thick vertical wavy lines. Post-firing graffiti-marks including Indus signs seen over the painting. Red ware of coarse fabric. From phase VA. Pl. CLXXX, *8*.

B72. Sherd painted in black over red on the exterior with groups of vertical wavy lines enclosed between horizontal bands. Multiple brush used. Red Ware of medium fabric. From phase VA. Pl. CLXXX, *9*.

B73. Sherd painted in black over red on the exterior with obliquely flowing wavy lines above a horizontal band. Red Ware of medium fabric. From phase VA. Pl. CLXXX, *10*.

B74. Sherd painted in black over red on the exterior with three vertical wavy lines below a horizontal band. Red Ware of medium fabric. From phase VB. Pl. CLXXX, *11*.

B75. Sherd painted in black on a light red slip almost as in 74 above. Red Ware of medium fabric. From phase VB. Pl. CLXXX, *12*.

B76. Large sherd of a high necked jar with thick wavy lines between two loops below two horizontal bands. Red ware of course fabric. From phase VA.

B77. Sherd painted in black over red on the exterior with a series of arches and filled triangles. Two oblique rows of zigzag line enclosed between oblique line. Red ware of coarse fabric. From phase VA.

B78. Sherd painted in black over red with a series of arches or filled inverted triangles below horizontal bands the interspace being used for drawing oblique wavy lines, between oblique band. Red Ware of medium fabric.

B79. Fragment of a bowl painted in black over red on the interior with arrow heads one below the other in a vertical row and on the exterior with oblique strokes above a horizontal band. A series of suspended loops occur below the band. Micaceous Red Ware of thin fabric. From phase VA.

B80. Sherd painted in black over red on the exterior with groups of vertical wavy lines enclosed between horizontal bands. A series of thick suspended loops occurs below the lower band. Red ware of coarse fabric. From phase VA.

B81. Fragment of a bowl painted in black over red on the interior with suspended loops enclosed between horizontal bands and wavy lines in groups of two further below. Horizontal band on the exterior. Red ware of coarse fabric. From phase VB.

B82. Fragment of a dish painted in black over light red on the interior with a horizontal wavy line above and below three horizontal bands; a wavy line above horizontal bands on the exterior too. Thick Red Ware of coarse fabric. From phase VA.

B83. Fragment of a dish painted in black over red on the interior with wavy lines above and below two horizontal bands and an arch-like wavy line on the exterior enclosed between horizontal bands. Another band at the shoulder. Red Ware of medium thickness. From phase VB.

Fig. 92

B84. Sherd painted in black over red on the interior with a horizontal band between two wavy lines. Red Ware of coarse fabric. From phase VB.

B85. Sherd painted in black over red on the interior with double intersecting loops and a wavy line between horizontal bands on the exterior. Micaceous Red Ware of medium fabric. From phase VA. Occurs in Rangpur II and Jhukar levels.

B86. Sherd painted in black over red on the exterior with a wavy line between double-line loops and horizontal bands. A vertical stroke also noticed. Micaceous Red Ware of medium fabric. From phase VA.

B87. Sherd painted in black over red on the exterior with zigzag lines between horizontal bands and a double line loop or perhaps hollow circles in the horizontal register. Micaceous Red Ware of medium fabric. From phase VB. Zigzag lines occur in Harappa levels at Chanhu-daro.[1]

B88. Sherd painted in black over orange red slip on the exterior with two double-line loops in opposite directions below horizontal bands. The ends are plumed. Micaceous Red Ware of coarse fabric. From phase VB.

B89. Sherd painted in black over red on the exterior with a double line loop having long plumes below horizontal bands enclosing thin zigzag line and oblique strokes. Micaceous Red Ware of coarse fabric. From phase V.B.

B90. Sherd painted in black over light red on the exterior with groups of oblique lines enclosed between horizontal bands. A vertical panel of chevrons between two vertical lines seen in the lower register. Micaceous Red Ware of medium fabric. From phase VA. Occurs in Jhukar levels[2] at Chanhu-daro and in Rangpur III.

B91. Sherd painted in black over light red on the exterior with a series of oblique strokes between three vertical lines in the upper register and a thick wavy line in the lower register the two being demarcated by three horizontal bands. Micaceous Red Ware of thin fabric from phase VA.

B92. Sherd painted in black over red on the exterior with a series of chevrons enclosed between vertical lines producing a stylised plant motif. Red Ware of medium fabric. From phase VA.

B93. Sherd painted in black over light red on the exterior with two cross-hatched loops meeting two horizontal bands above which oblique lines are seen. Micaceous Red Ware of coarse fabric. From phase VB.

B94. Sherd painted in black over red with a cross-hatched vertical panel above two horizontal bands below which runs a wavy line. Micaceous Red Ware of medium fabric. From phase VA. Occurs along with other designs in the Indus pottery in Harappan levels.[1]

B95. Sherd painted in black over orange red with two cross-hatched vertical panels slightly tapering at the top meeting the horizontal band. Micaceous Red Ware of medium fabric. From phase VB.

B96. Sherd painted in black over red on the exterior with a series of open-net designs hanging from a horizontal band. Micaceous Red Ware of medium fabric. From phase VA. Occurs in the Indus pottery in Harappan levels.

B97. Sherd painted in black over red on the exterior with two cross hatched panels one of which is vertical and the other oblique. Red Ware of thin fabric. From phase VB.

B98. Sherd painted in black over red on the exterior with a loop below two horizontal bands. Also an oblique line further below. Red Ware of thick fabric. From phase VA. Pl. CLXXXI A, *1.*

B99. Sherd painted in black over red on the exterior with a loop and cross-hatched panel below a horizontal band. Red ware of coarse fabric. From phase VB. Pl. CLXXXI A, *2.*

B100. Sherd painted in black over red on the exterior with two roughly drawn loops with wavy ends enclosed between horizontal bands. Micaceous Red Ware of medium fabric. From phase VA. Pl. CLXXXI A, *3.*

B101. Sherd painted in black over red on the exterior with two labyrinth-like loops above a horizontal band. Red Ware of medium fabric. From phase VA. CLXXXI A, *4.*

B102. Sherd painted in black over red on the exterior with several wavy lines enclosed between horizontal bands and an almost circular loop springing from another thick band below. Micaceous Red Ware of coarse fabric. From phase VB. Pl. CLXXXI A, *5.* Occurs in Prabhas II.[4]

B103. Sherd painted in black over red on the exterior with two inter twining labyrinth-like loops enclosed between horizontal bands. Red Ware of medium fabric. From phase VB. Pl. CLXXXI A, *6.* Occurs at Bara.[5]

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[1] Mackay *op. cit.* 1943, pl. XXIII, *6.*

[2] *Ibid,* pl. XLVII, *13* and *27.*

[3] *Ibid,* pl. XXXIV, *6.*

[4] *Indian Archaeology,* 1956-57, *A Review,* pl. LXXXI.

[5] *Ibid.* 1954-55, pl. XI.

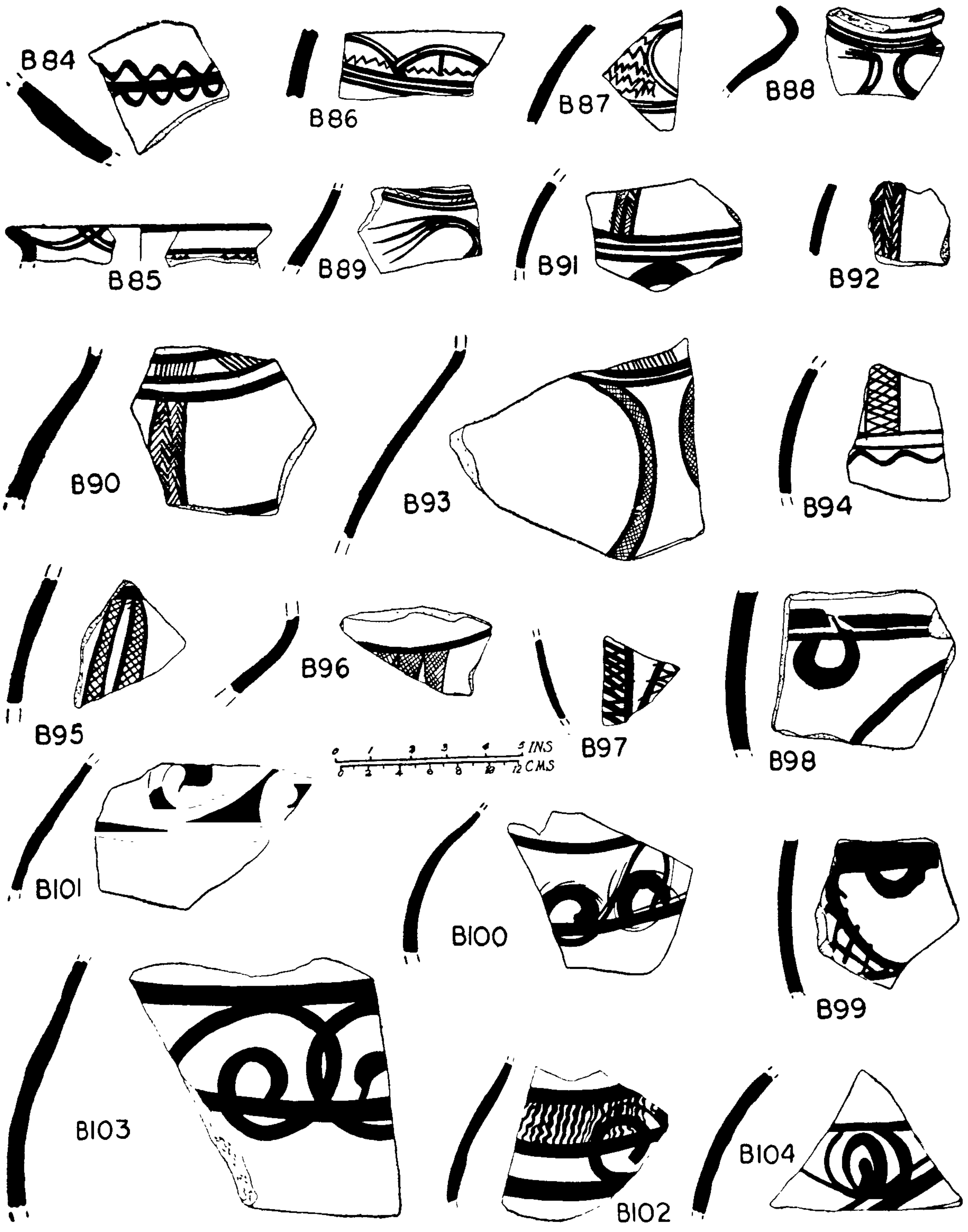

FIG. 92. *Painted sherds, Period B, B84 ta B104*

B104. Sherd painted in black over red on the exterior with a labyrinth between horizontal and oblique bands. Red Ware of medium fabric. From phase VB. Pl. CLXXXI A, *7.*

Fig. 93

B105. Sherd painted in black over red on the exterior with two loops having fronds perhaps suggesting conventional creepers. One of the loops partially visible. Three horizontal bands seen below. Red ware of coarse fabric. From phase VB. Pl. CLXXXI B, *1.* Also occurs in Period IIC and III at Rangpur. Loops with circular or labyrinth like ends occur in the Jhukar levels of Chanhu-daro.

B106. Sherd painted in black over a red slip on the exterior with a fronded loop with a pellet at the circular end between two horizontal bands. Some fronds in the corner suggest another loop-with-frond. Red ware of coarse fabric. From phase VB. Pl. CLXXXI B, *2.* Occurs at Prabhas in Period I B.[1]

B107. Sherd painted in black over red on the exterior with a thick loop-with-fronds above horizontal bands of varying thickness. An oblique line touching the fronds suggests division of the horizontal register into compartments. Red ware of thick fabric. From phase VB. Pl. CLXXXI B, *3.* Occurs at Bara.[2]

B108. Sherd painted in black over red on the exterior with a loop-with-fronds and an oblique line over a thick horizontal band as in *B107* above. Red Ware of medium fabric. From phase VA. Pl. CLXXXI B, *4.*

B109. Sherd painted in black over red on the exterior with a loop-with-fronds enclosed in a series of arches below horizontal bands. Red Ware of medium fabric. From phase VA. Pl. CLXXXI B, *5.*

B110. Sherd painted in black over a light red slip on the exterior with long fronds perhaps on two loops below a horizontal band. Red Ware of medium fabric. From phase VB. Pl. CLXXXI B, *6.*

B111. Sherd painted in black over red on the exterior with a cross-hatched circle-with-fronds below two horizontal bands above which is a group of oblique strokes. Micaceous Red Ware of thin fabric. From phase VA. Pl. CLXXXI B, *7.* Cross-hatched loop or circle without fronds. Occurs on Indus pottery in the Harappan[3] and Jhukar levels[4] of Chanhu-daro.

B112. Sherd painted in black over a red slip on the exterior with a loop above horizontal bands. Cross-hatching of the interspace perhaps between two loops. Red Ware of medium fabric. From phase VA. Pl. CLXXXI B, *8.* Such cross-hatching between loops is noticed on the Indus pottery in the Harappan and later levels all over.

B113. Same as above but the circular end of the loop is more clearly visible. Hatching neatly executed. Red Ware of medium fabric. From phase VA. Pl. CLXXXI B, *9.*

B114. Sherd painted in black over red on the exterior with a cross-hatched panel enclosed between horizontal bands. Lines thin out at the ends. Red Ware of medium fabric. From phase VA. This design occurs frequently on Indus pottery in Harappan and later levels all over.

B115. Same as above but the lines of uniform thickness in the hatched panel. Red Ware of medium thickness. From phase VB.

B116. Cross-hatching as in *B115* above. Besides three horizontal bands a vertical line suggests division of the horizontal register into compartments. Red Ware of medium fabric. From phase VB.

B117. Same as in *B115* but one series of oblique lines thicker than the other in the hatching No horizontal bands seen. Red Ware of medium fabric. From phase VA.

B118. Sherd painted in black over red on the exterior with cross-hatched panel below two horizontal bands. A filled inverted triangle or perhaps the junction of two arches indicated above the bands. Red Ware of medium fabric' From phase VA.

B119. Sherd painted in black over red on the exterior with a cross-hatched cricle and a fragmentary

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[1] *Indian Archaeology,* 1956-57, *A Review* pl. XXXVI, *16* and *17.*

[2] *Ibid* 1954-55. pl. XI.

[3] Mackay *op. cit.* 1943 pl. LXIX, *21.*

[4] *Ibid* pl. XLV, *28, 30, 35, 37.*

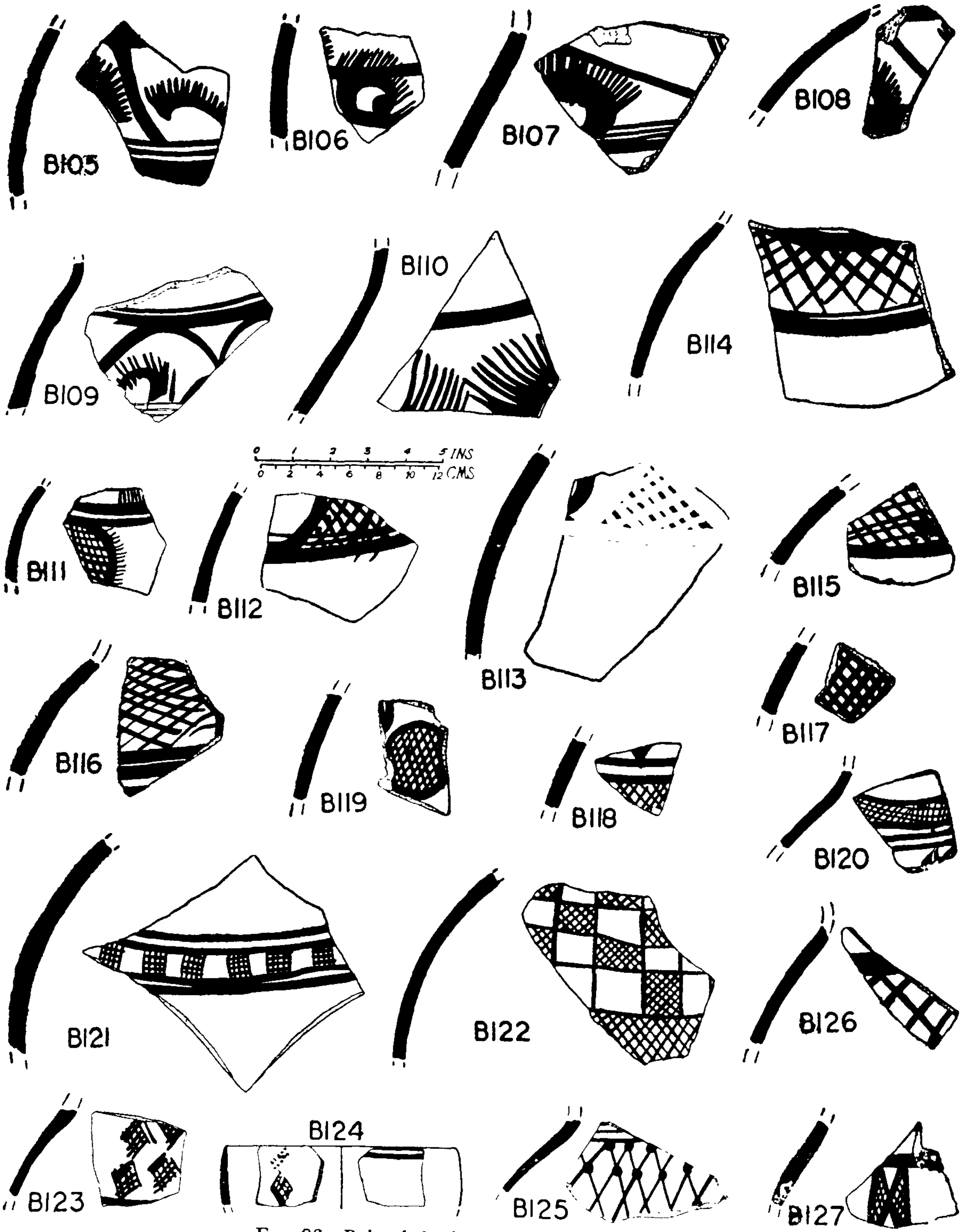

FIG. 93. *Painted sherds, Period B, B105 to B127*

loop above. Red Ware of medium fabric. From phase VB. This design occurs on Harappan and Jhukar pottery in the Indus valley.

B120. Sherd painted in black over red on the exterior with a corss-hatched panel above horizontal bands. Lines not uniform in thickness and design hastily executed. Red ware of thin fabric. From phase V.B.

B121. Sherd painted in black over red on the exterior with a panel of hatched squares enclosed between horizontal bands. Micaceous Red Ware of medium fabric. From phase VB. Occurs at Mohenjo-daro.[1]

B122. Sherd painted in black over red on the exterior with alternately hatched squares in a chess-board pattern above a cross-hatched panel. Red Ware of medium fabric. From phase VB. Occurs on Indus pottery in Harappan levels.

B123. Sherd painted in black over red on the exterior with four cross-hatched diamonds above a horizontal band. Micaceous Red Ware of medium fabric. From phase VA.

B124. Fragment of a bowl painted in black over an orange red slip with a cross-hatched diamond on the interior and two horizontal bands on the exterior. Micaceous Red Ware of medium fabric. From phase VA.

B125. Sherd painted in black over light red on the exterior with intersecting oblique lines in criss-cross pattern and two rows of dots at the intersecting points. Horizontal bands at the top. Red Ware of medium fabric. From phase VB.

B126. Sherd painted in black over light red with intersecting oblique lines almost as in *B125* but without the dots. Red ware of medium fabric. From phase VA.

B127. Sherd painted in black over red on the exterior with two hatched triangles meethіng at the apex producing an axe design. Micaceous Red Ware of medium fabric. From phase VA.

Fig. 94

B128. Sherd painted with a long leaf hatched across and a conventional flower motif produced by adding balls at the tips of eight intersecting lines. A thick dot in the centre of the flower which has a long stalk. Another flower partially visible above the leaf and three horizontal bands are painted below. Red Ware of thick fabric. From phase VB. Pl. CLXXXII A, *4*. Ball-and-stem motif noticed in the flower above occurs in the Harappa levels also at Chanhu-daro.[2]

B129. Sherd painted in black over red on the exterior with a conventional floral design by adding pellets at the ends of intersecting lines and enclosing the same between horizontal bands. Micaceous Red Ware of medium fabric. From phase VA. Pl. CLXXXII A, *2*. Occurs at Rangpur in period III.

B130. Sherd painted in black over red on the exterior by hatching alternate petals formed by the intersecting arcs. Red Ware of medium fabric. From phase VA. Occurs on Indus Valley pottery in Harappan levels. Example of a Harappan motif and style occurring in Period B. Pl. CLXXXII A, *3*.

B131. Sherd painted in black over red on the exterior with a conventional floral design above horizontal bands, petals formed by the intersecting arcs. Red Ware of medium fabric. From phase VA. Another example of Harappan motif and style occurring in Period B. Pl. CLXXXII A, *4*.

B132. Sherd painted in black over red on the exterior with conventional floral designs in compartmented squares. Red Ware of thick fabric. From phase VB. Pl. CLXXXII, *5*. Example of Harappan motif and style occurring in Period B.

B133. Sherd painted in black over red on the exterior with a floral design of which the ball-and-stem and a petal are visible above three horizontal bands. Red Ware of medium fabric. From phase VB. Pl. CLXXXII A, *6*.

B134. Sherd painted in black over a buffish red slip on the exterior with row of balls enclosed between horizontal bands. Three more bands seen below. Red Ware. From phae VB.

B135. Sherd painted black over red and buff slips on the exterior with two rows of balls, one on the

[1] Marshall *op. cit.* 1931, II, pl. XCII, *11* to *13*.

[2] Mackay *op. cit.* 1943, pls. XXXVII, 4 and XXXVIII, *22*.

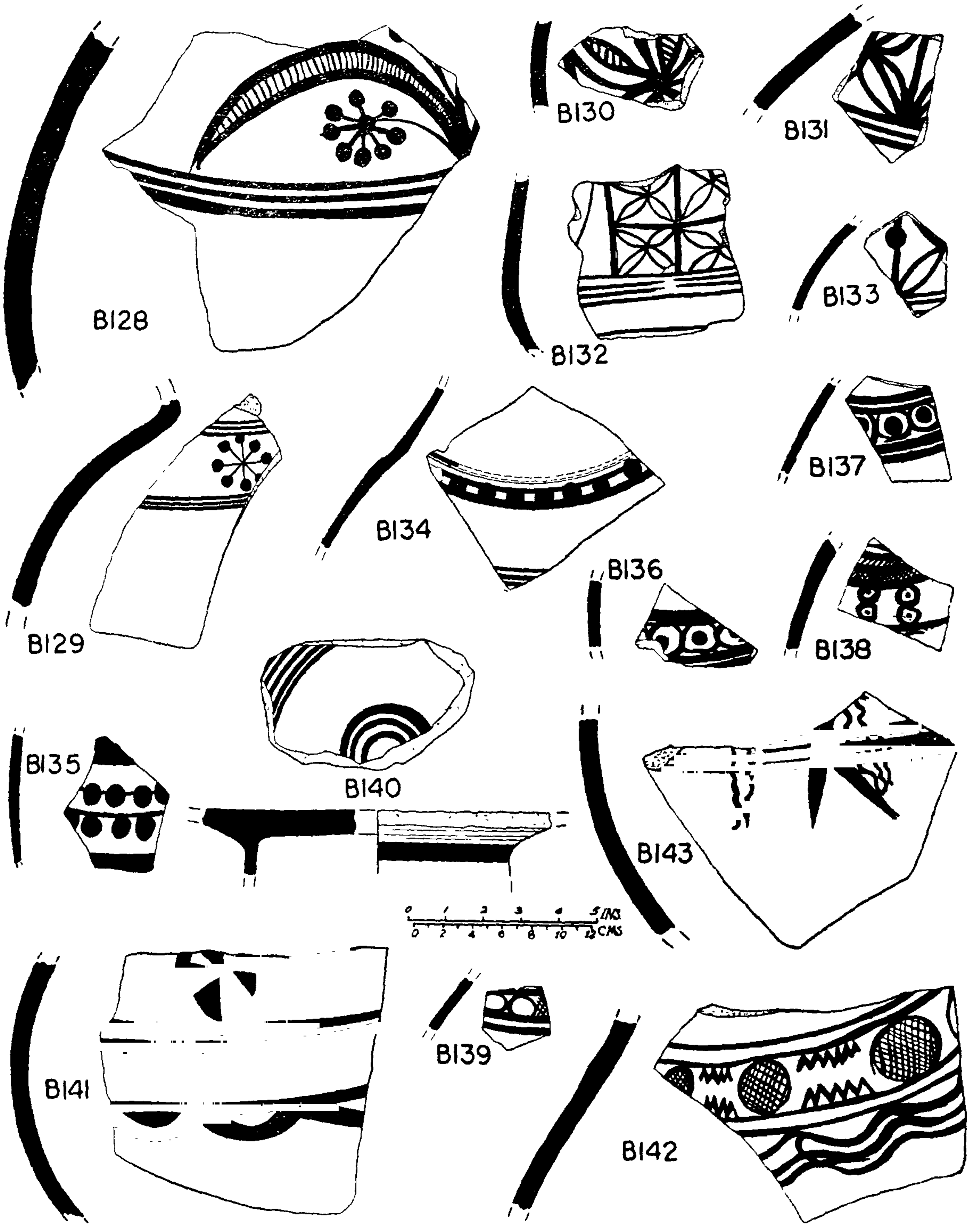

FIG. 94. *Painted sherds Period B, B128 to B43*

upper horizontal band and the other below the lower one. A thick band visible on top. Buff Ware of medium fabric. From phase VA. Occurs at Rupar[1] and in Period II at Rangpur.[2]

B136. Sherd painted in black over red on the exterior with a row of dots enclosed in circles between horizontal bands. Red Ware of medium fabric. From phase VB. Occurs at Mohenjo-daro[3] and other Harappan sites.

B137. Almost same as above. The dots are however thicker. Red Ware of thick fabric. From phase VA.

B138. Sherd painted in black over orange red slip on the exterior with four circle-and-dots in two vertical rows of two circles each between horizontal bands. The middle panel consists of cross hatching and the upper one of oblique strokes, each enclosed between horizontal bands. Micaceous Red Ware of medium fabric. From phase VA. Alternate panels of cross-hatching and oblique strokes occur in Harappan levels at Chanhu-daro.[4]

B139. Sherd painted in black over red on the exterior with two hollow circles and cross-hatching between horizontal bands. Red Ware of medium fabric. From phase VB.

B140. Fragment of a dish-on-stand painted in black over a red slip on the interior of the dish-part with concentric circle in the centre as well as the periphery. Red Ware of medium fabric. From phase VA.

B141. Sherd painted in black over red on the exterior with a whell motif or perhaps flower above two horizontal bands. Alternate triangles filled in the floral design. A series of loops suspended from a horizontal band in the lower panel. Micaceous Red Ware of medium fabric. From phase VB. Pl. CLXXXII B, *1*.

B142. Sherd painted in black over an orange red slip on the exterior with a row of hatched circles and two zigzag lines between each circle in the upper register enclosed between horizontal bands. Three wavy lines run below the bands horizontally. Micaceous Red Ware of thick fabric. From phase VA. Pl. CLXXXII B, *2*.

B143. Sherd painted in black over red on the exterior with vertical wavy lines in groups on either side of two thick intersecting lines over three horizontal bands. Red Ware of thick fabric. From phase VA.

Fig. 95

B144. Sherd painted in black over red on the exterior with a long leaf or plant motif and perhaps a floral design similar to 'X' above two horizontal bands. Red ware of thick fabric. From phase VA.

B145. Sherd painted in black over light red on the exterior wtih two thick zigzag lines each enclosed between horizantal lines drawn in groups of two. A vegetable motif partially visible below. Micaceous Red Ware of thick fabric. From phase VB.

B146. Sherd painted in black over orange red with a zigzag line enclosed between horizontal lines drawn in groups of two. A cross-hatched diamond partially visible below a double-line arc. Micaceous Red Ware of medium fabric. From phase VA.

B147. Sherd painted in black over purple on the exterior with two arcs with leaf-like strokes which suggest plants. Enclosed between horizontal bands. Red Ware of medium fabric. From phase VA. Occurs at Bara.[5]

B148. Sherd painted in black over red on the exterior with two zigzag lines. one below the other and enclosed between horizontal lines. Oblique lines closely drawn below the horizontal ones. Micaceous Red Ware of thick fabric. From phase VB.

B149. Sherd painted in black over red on the exterior with a series of oblique lines ending in dots above two horizontal bands. Perhaps a plant motif was indicated. Micaceous Red Ware of medium fabric. From phase VB.

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1 *Indian Archaeology,* 1953-54 *A Review*, pl. IV.
2 S. R. Rao *op. cit.* 1963, fig. 26,32.
3 Marshall *op. cit.* III, 1931, pl. XCI, *26*.
4 Mackay *op. cit.* 1943, pl. XXXVII, *38*.
5 *Indian Archaeology* 1954-55, *A Review,* pl. XIA.

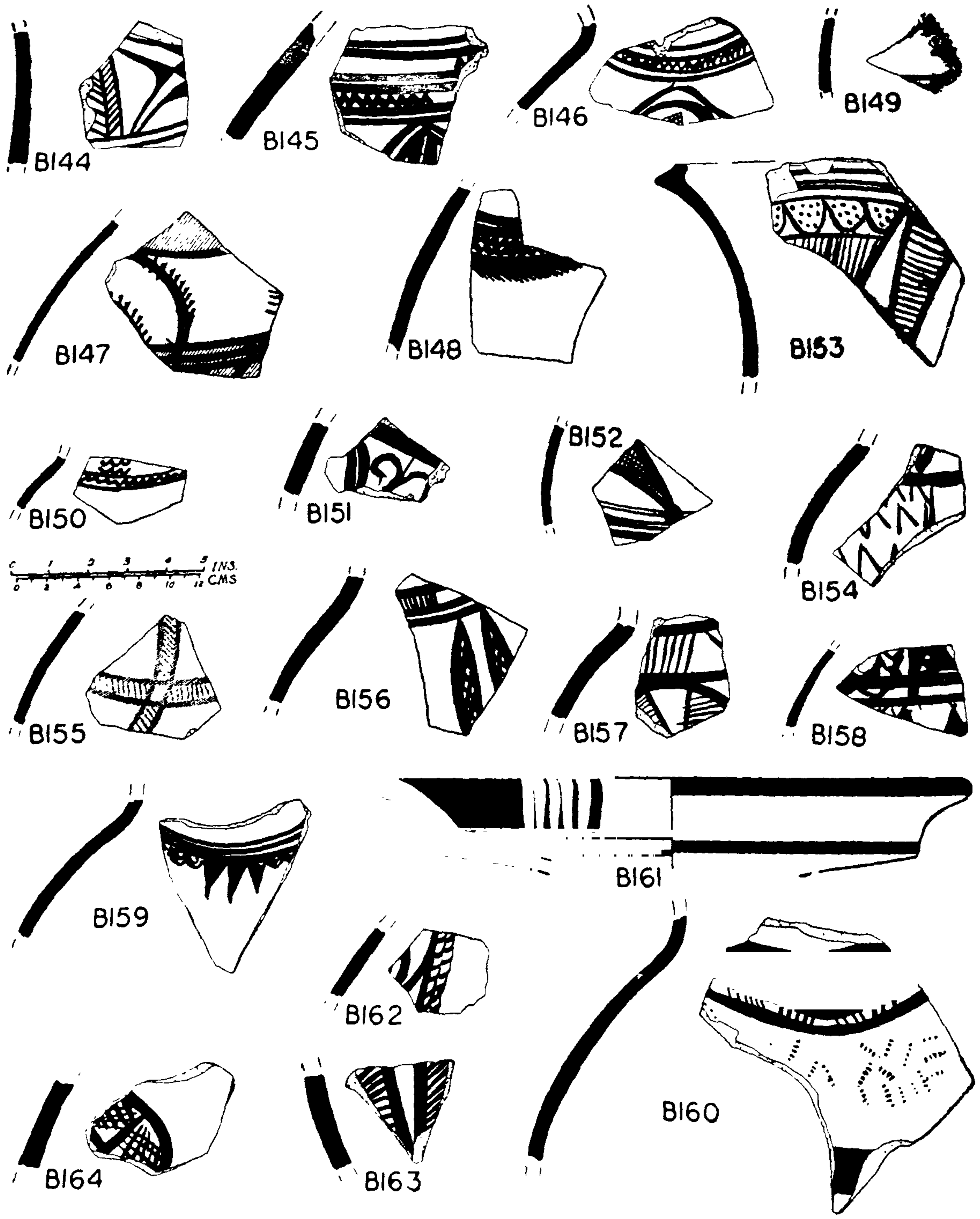

FIG. 95. *Painted sherds, Period B, B144 to B164.*

B150. Sherd painted in black over a light red slip on the exterior with two wavy horizontal lines below which a long way line is enclosed between horizontal bands. The short ones may suggest water. Micaceous Red Ware of medium fabric. From phase VA. Occurs at the Indus sites in Harappan and later levels.

B151. Sherd painted in black over light red on the exterior with a leaf besides another motif. Two hook like loops drawn in opposite directions from a central line. An oblique band also noticed. Micaceous Red Ware of medium fabric. From phase VB.

B152. Sherd painted in black over red on the exterior a cross-hatched leaf-motif with a dot at the tip. Horizontal bands drawn below. Red ware of medium fabric. From phase VA.

B152. Fragment of a 'S'-shaped vessel painted in black over red on the exterior with horizontal bands and a series of suspended loops with dots on vessel surface divided into compartments for painting. Vertical lines are drawn in one compartment and horizontal lines in a ladder pattern enclosed between arcs in another. Red Ware of medium fabric. From phase VA. Schematisation and over-all treatment. Example of continuation of Harappan shape of vessel, motifs and style of painting in Period B.

B154. Sherd painted in black over red on the exterior with oblique strokes in the form of inverted 'V'-almost as in a chevron below a thick horizontal band. Micaceous Red Ware of medium fabric. From phase VA.

B155. Sherd painted in red over a buff slip on the exterior with two intersecting double-arcs hatched across. Buff slipped Red ware of medium fabric. From phase VA.

B156. Sherd painted in black over a light red slip on the exterior with two cross-hatched leaves with a tapering end below a group of oblique lines enclosed between horizontal bands. Micaceous Red Ware of medium fabric. From phase VA. Hatched leaf occurs in Harappa also.[1]

B157. Sherd painted in black over a light red slip on the exterior with a group of vertical lines enclosed between horizontal bands in the upper panel. Lower panel divided into hatched compartments by oblique line. Micaceous Red Ware of medium fabric. From phase VB.

B158. Sherd painted in black over red on the exterior with suspended loops one below the other on two horizontal bands below which some filled triangles are partially visible. Red Ware of medium fabric. From phase VB.

B159. Sherd painted in black over red on the exterior alternately with groups of loops and filled triangles suspended from horizontal bands. Micaceous Red Ware of medium fabric. From phase VA.

B160. Sherd painted in black over red on the exterior with oblique lines in groups between a very wide horizontal band and a narrow one. Also an idenfinite design produced by rows of dots running in different directions visible besides a thick horizontal band below. Micaceous Red Ware of medium fabric. From phase VB.

B161. Fragment of a dish painted in black over red across the rim with groups of thick lines as also with concentric bands on the interior. Horizontal bands noticed on the exterior too. Red ware of medium fabric. From phase VA. Painting across the rim of the dish is noticed on Harappan dishes in the Indus Valley.

B162. Sherd painted in black over light red slip on the exterior with two vertical rows of loops adjoining a vertical band to which a spiral is attached. Micaceous Red Ware of medium fabric. From phase VB.

B163. Sherd painted in black over red with two vertical panels hatched with oblique lines as in *B157* above. Red Ware of medium fabric. From phase VB.

B164. Sherd painted in black over red on the exterior with a heart-shaped design and hatched in four compartments. Micaceous Red Ware of thick fabric. From phase VA.

E. Incised Ware

A jar of medium thickness in coarse red ware is decorated with incised nail-tip design at the shoulder. It comes from the lower level of Period B, (fig. 87, *281*). Another jar from the middle level of Period B, also of medium thickness in coarse red ware bears notches incised in horizontal rows at the shoulder. From middle level of Period B (fig. 87, *281b*).

[1] Vats *Excavations at Harappa.* 1940, pl. LXVII, 28.

G. Burial Pottery

In most of the single burials two to four pots constituting the grave furniture were found placed with the dead but in none of the three joint-burials was any pottery found. On the whole the ceramic equipment was very poor. The pots were generally placed near the head but in two cases they were found placed near the waist. Some of the jars lay on their sides and upside down in grave no. 13 which is greatly disturbed by flood etc. (pl. CXXII).

The ceramic wares from the graves are better preserved than those from elsewhere as they are not disturbed once they are placed in the grave pits. The Red Ware and the Micaceous Red Ware were preferred to others for funerary purpose. Most of the vessels recovered from the graves have been heavily affected by salt resulting in the disappearance of the painting and slip too. Bowls with or without handle, jars of medium and small size, the carinated dish, basin, the lota-shaped vessel and the dish-on-stand are the main types found from the cemetery.

Of most frequent occurrence is the water pot with flared rim and round bottom in the Micaceous Red Ware, (fig. 95, *6*). The horizontal bands painted at the shoulder have disappeared. The lota and high-necked jar with a globular body and round base are two important types (fig. 95, *2* and *3*) found in the grave pit no. 5 which is assigned to Period B. Some of the jars and lotas have been painted in black horizontal bands, wavy lines, loops or dots on the shoulder and interesecting loops or bands on the rim (fig. 96). A wide-mouthed jar with a round base also occurs in the cemetery (fig. 95, *1*). The small jar with a flat base (fig. 95, *4*) is rare. On the other hand the bowl with convex sides and round base (fig. 95, *10*) in the Red Ware as well as the Micaceous Red Ware painted with black horizontal bands on the shoulder and suspended loops on the rim (fig. 96, *10a*) was more popular. Another important type occurring in a couple of graves is a small bowl with a stud-handle painted on the exterior of the rim with black bands (fig. 96, *12*).

The dish-on-stand from the cemetery is also vary much affected by salt and does not retain any trace of painting or slip. One of the dishes-on-stand found here has a moulded stem. The dish has a splayed rim and carinated shoulder (fig. 96, *9*).

The bulk of funerary wares are in the Associated ware group. The typical dish-on-stand with carinated shoulder and jar with a small neck are among the Harappa wares found in the cemetery. The graves of phase V yielded the evolved Harappan types such as high necked jar, lota and are painted with loops, dots etc. (fig. 96, *3*). It is interesting to note that in one of the graves at Rupar a lota-shaped vessel of Lothal B type was found.[1]

Fig. 96

Type 1. Jar of medium thickness with wide mouth, everted beaked rim and globular body in Red Ware. From burial no. 14 of Period A, phase IV.

Type 2. Jar of medium thickness with beaked rim, high neck and ovoid body in red ware. Painted in black horizontal bands at the rim and recurved loops between horizontal bands at the belly. From burial no. 5 of Period B, Phase V.

Type 3. Small lota-shaped jar of thin fabric with flaring mouth, high neck and globular body. Painted in black with intersecting loops below a horizontal band at the rim and horizontal bands enclosing and partially overlapping wavy lines forming leaf designs over red exterior in red ware. From burial no. 15 of Period B. Pl. CLXXXIII A, *1. Variant 3a,* has blunt carinated shoulder and elongated neck in Red Ware. Slip disappeared on account of water action. From burial no. 6 of Period A. Phase IV. Pl. CLXXXIII A, *2.*

[1] *Indian Archaeology,* 1954-55, *A Review* pl. VII B.

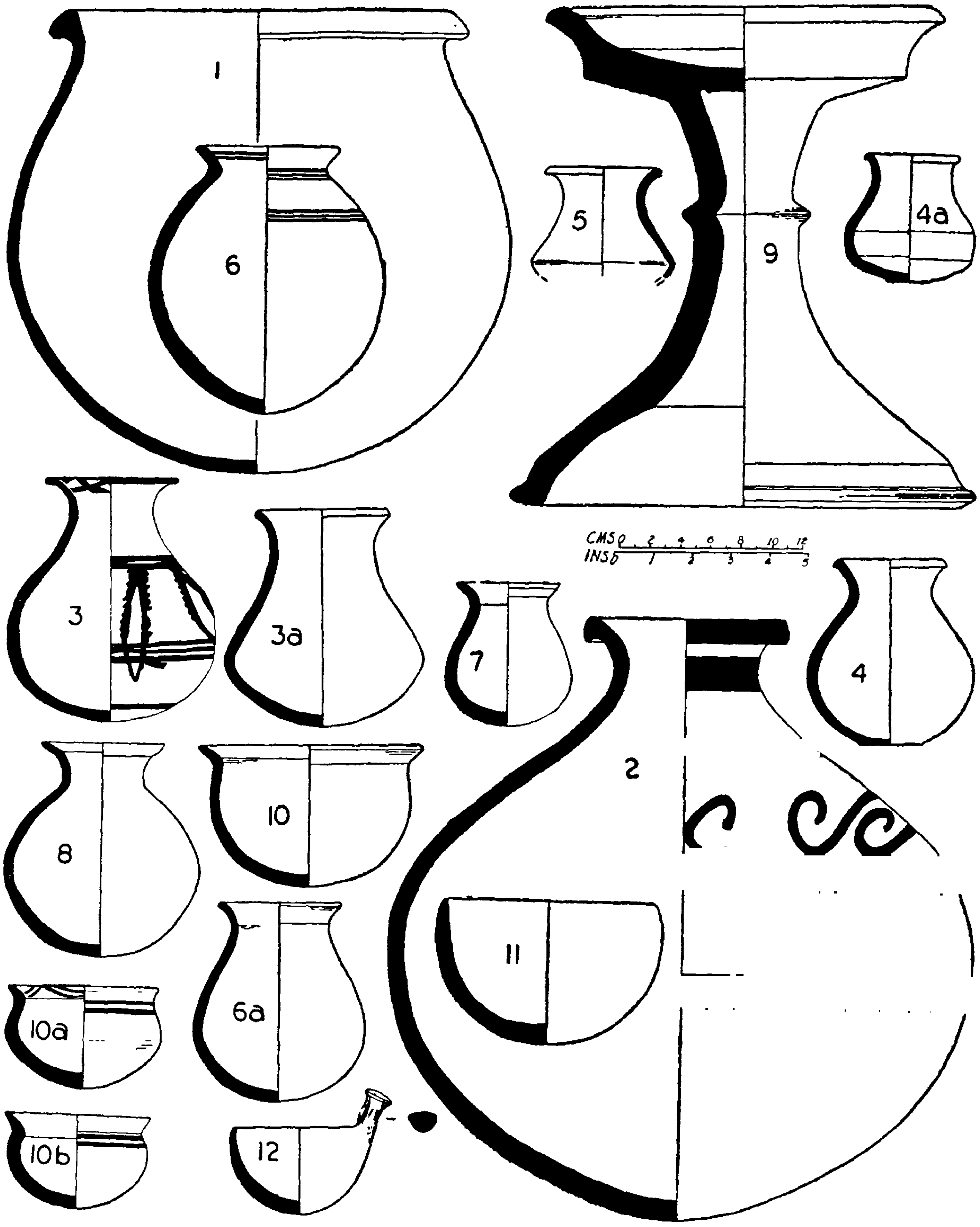

FIG. 96. *Burial Pottery, Periods A & B, Types 1 to 12*

Type 4. Small jar of thin fabric with beaked rim, globular body and flat base in Red Ware. From burial no. 14. of Period A, Phase IV. Pl. CLXXXIII A, *3. Variant 4a,* is distinguished by its concavo-convex profile. From a disturbed burial of Period A.

Type 5. Small jar or bowl of thin fabric with beaked rim, elongated neck and carinated shoulder in Red Ware. From burial no. 13 of Period A, Phase IV. Pl. CLXXXIII C, *1.*

Type 6. Jar of medium thickness with flaring rim and ovoid body in Micaceous Red Ware. Painted in black horizontal band and loops at the rim and horizontal bands at the shoulder over light red. From burial no. 6 of Period A, Phase IV A. Pl. CLXXXIII A, *4. Variant 6a,* is smaller and has a flaring rim. From burial no. 12 Period A, Phase IV. Pl. CLXXXIII A, *5.*

Type 7. Small jar of medium thickness with flaring mouth and ovoid body in Micaceous Red Ware. From a disturbed burial of Period A.

Type 8. Small jar of medium thickness with flaring knife-edged rim and globular body in red ware. From burial no. 10 of Period B, Phase V. Pl. CLXXXIII A, *6.*

Type 9. Dish-on-stand of medium thickness with recurved base, and a prominent rib below the drum in Red Ware. The dish has splayed out rim and carinated shoulder. From burial no. 11 of Period A, Phase IV. Pl. CLXXXIII B.

Type 10. Bowl of thin fabric with flaring rim, convex sides and round base in Micaceous Red Ware. From a disturbed burial of Period A. Pl. CLXXXIII C, *2. Variant 10a,* has short everted rim. Painted in black with loops at the rim and horizontal bands at the neck. From burial no. 11 of Period A. Phase III. Pl. CLXXXIII C, *3. Variant 10b,* differs slightly from *295a,* in the shape of rim. From burial no. 11 of Period A, Phase IV. Pl. CLXXXIII C, *4.*

Type 11. Bowl of medium thickness with convex sides and featureless rim in Micaceous Red Ware. From burial no. 14 of Period A, Phase IV. Pl. CLXXXIII C, *5.*

Type 12. Bowl of medium thickness with stud handle and convex profile in Micaceous Red Ware. Surface water-worn. From a disturbed burial of Period A. Pl. CLXXXIII C, *6.* A similar one occurs at Koth. Pl. CLXXXIII C, *7.*

7. POTTERY OF FOREIGN ORIGIN

Lothal has yielded twenty potsherds of non-Harappan origin. In fabric, surface treatment and decoration they do not compare with any of the Harappan and associated wares of local origin. On the other hand they bear close resemblance to some of the ceramic wares from Mesopotamia (Pl. CXC A-B). The extremely limited quantity in which the non-Harappan sherds are found, not more than four sherds in any group, is itself an indication that they were not locally manufactured. Three main ceramic wares namely the Reserved Slip Ware, the Ubaid ware and the pseudo-half-ware are distinguished among the foreign wares.

A. Reserved Slip Ware

Some varieties of Reserved Slip Ware viz., of red, cream, grey and light grey fabric have been found at Lothal. In all these cases the technique consists in applying a second slip over the first one covering the body surface and removing partially the upper slip with a sharp, comb-like instrument so as to expose the lower slip side by side with the upper one.

Pl. CLXXXIV A.

C1. Part of dish in red ware of medium fabric, treated with pink and white slips, comb work producing wavy lines noticed on the interior. From SRG 2, BX 4, layer 2; Phase IV. This is a late imitation of the Reserved Slip Ware of red fabric from phase III.

C2. Thin red ware of superior fabric treated with reddish and white slips; comb work producing fine wavy lines. From SRG 2, E 28, layer 6; phase III. Compare a similar sherd from Brak. A greenish buff sherd treated with pink and white slips and showing comb-work occurs in E 25 Phase II.

C3. Cream ware of medium fabric treated with pink and grey slips; comb-work producing parallel horizontal lines. Crude workmanship; late imitation. From a mud-brick house in SRG 2, E 25, layer 5, phase IVa.

C4. Whitish grey ware of medium fabric with a soapy finish. Exterior treated with grey and white slips. Parallel band produced by comb-work. From SRG 2, H 8, layer 6, phase III.

C5. Rim of a bowl in grey ware of medium fabric; treated with grey and white slips, comb-work. Imitation ware From SRG 2, E 28, layer 4, phase IV.

C5. Greyish-red ware of thin fabric; treated with pink and grey slips, comb-work producing parallel wavy lines as well as horizontal bands; superior workmanship. From phase III of SRG 3, H 28, layer 6.

C6. Red ware of thin fabric; treated with pink and grey slips producing parallel wavy and horizontal lines; crude workmanship. Imitation ware. From SRG 3, H 10, layer 3, phase IV.

C7. Sturdy ware of light grey medium fabric. treated with white and black slips and upper slip partially removed by comb-work. Superior workmsnship. Slips have penetrated into the fabric as if polished. From a mud-brick platform of phase II in SRG 2, J 5, layer 5. This is an early specimen of Reserved Slip Ware.

C8. Thin sturdy ware of light grey fabric. treated with grey and ashy grey slips; parallel wavy lines produced by comb-work. The earliest specimen of Reserved Slip Ware. From SRG 1, VI-X layer 9, phase II. Compare similar sherds from Brak (Pl. CLXXXIV B).

C9. Thin sturdy ware of light grey fabric; treated with white and black slips on the exterior and upper slip partially removed by comb-work producing parallel horizontal bands. From SRG 3, J 5, pit sealed by layer 4, phase III.

There are two more sherds of coarse dark grey fabric which are similarly treated, from layer 2 of SRG 3, G 11, but the slips have flaked off. The imperfect firing and surface treatment clearly indicate that they are imitations.

B. Other Foreign Wares

C10. Fragment of a bowl or jar of coarse medium fabric in buff painted in chocolate with multiple wavy lines between horizontal bands. Chocolate slip applied in a wide band below. From phase II. Compare similar sherds from Ubaid levels of Arpachiya and Niveau III 3 of Ras Sharma Ugarit. Pl. CLXXXIV B, *5.*

C11. Rim fragment of a jar (?) in coarse buff ware of medium fabric painted in chocolate with oblique lines enclosed by horizontal bands. From SRG 2, B 28. Pit sealed by layer 5. Compare similar sherds from 'Ubaid levels of Arpachiya and Neveau III, 3 of Ras Sharma-Ugarit. Pl. CLXXXIV B *6.*

C12-13. Two sherds of buff ware of medium fabric made of finely levigated clay. Painted in dark chocolate wavy lines between wide bands applied both horizontally and vertically dividing the vessel surface into compartments. From SRG 2, C 23 layer 4, phase III B. Compare similar sherds from Halaf levels of Arpachiya and Ugarit. Pl. CLXXXIV B. *1-2.* The Lothal specimen seems to be an imitation of a late survival.

Prabhas Ware

15-16 Two sherds of bowls in Prabhas Ware of mossy grey fabric, vertical wavy lines, painted in pink over a buffish gry surface. From Period B similar sherds occur in Prabhas I-B.

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[1] I am grateful to the Director of the Institute of Archaeology, London and to Sir Max Mallowan for permitting me to study the excavated finds from the West Asian sites.

Certain broad conclusions can be drawn from a comparison of the twenty and odd sherds of foreign origin found at Lothal. The majority of them are treated in reserve slip technique. All of them must have been imported. Some reserve slip sherds especially those occurring in phase IV at Lothal are crude and appear to be imitations, but those found in the early levels of phase III and in phase II are finer. It is also significant that a considerable number of the reserve slip ware sherds come from the northern half of Lower town namely C 25 to E 28 in streets 1 and 9 where merchant-community lived. The other sector where they occur is the warehouse area Obviously these sherds must have come in the course of sea-borne trade.

It is however difficult to explain the occurrence of characteristic Ubaid Ware sherds in phases II and III which may push back the date of phase II of Lothal to the beginning of the third millennium. A couple of sherds imitating Halaf Ware (13) and three more sherds (17-19) of non-Harappan origin also occur here. It may be assumed that this ware survived for a long time outside the epicentre of the Ubaid ware wherefrom Lothal imported. This applies to the Halaf ware occurring as late as phase IIIB at Lothal. However the value of the foreign sherds, especially the reserve slip ware occurring in two sectors has helped greatly in cross- dating. The closing date of phase IIIB based on C-14 test is 1883 B.C. The reserve slip ware assigned to Sargonid period in Brak, Ur, Arpachiya etc., occurs in phases IIb and IIIa at Lothal. Hence it would be fairly accurate if phase II with its three sub phases is dated 2100-2350 B.C. Reserved Slip Ware occurs in Mohenjo-daro also.[1]

8. MINIATURE VESSELS

Almost all the major types of Harappan pottery are reproduced in their miniature form at Lothal. The majority of them are hand-made and a few are wheel-turned. The hand-made vessels are generally rough and crudely shaped and appear to be in most cases the workmanship of children. They have a flat base but a few have a pointed base and broad shoulder. The miniature vessels in the Micaceous Red Ware from phase IV have a round bottom, globular body and flaring rim. One specimen has, however, a flat base. Jars are painted in black over red, chocolate or buff on the rim or shoulder with wavy lines, horizontal bands, loops and strokes. The finest example of Provincial style of painting is a miniature 'S'-shaped vase on which an antelope is painted in the most relistic way (fig. 84, *A 55*).

The trough with a round or flat bottom, the dish-on-stand, bowl, spouted pot, cylindrical perforated jar, votive lamp and the pan of the balance are hand-made. The troughs are given a red wash but many others are neither slipped nor washed. None of them is painted. A jar with a pointed base has finger-tip impressions on the shoulder. Most of the miniature vessels are just copies of their prototype in larger size as at Jamdet Nasr and in Crete. In Crete they were found to be votive in character, but it is difficult to say whether the miniature vessels were also votive at Lothal. Perhaps they were used as toys by children. The small jar with a narrow mouth might have been used as a container for cosmetics.

A. Coarse Hand-made Vessels

Pl. CLXXXV A

1-2, Jars with flaring rim and carinated shoulder and flat base.

3-5. Jars with beaded rim, small neck, bulbous body and round base.

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[1] Mackay *op. cit.* 1938, II, pl. LXVII, *4*.

6. Jar with raised neck and footed base.
7. Bulbous jar without any neck.
8. Trough with straight sides.
9. Cylindrical jar with projected rim.
10. Bowl with footed base.

Pl. CLXXXV B

11-13. Jars with flaring rim, convex profile and round base.
14. Trough-like jar with high walls.
15. Jar with slight carination near the base.
16. Vase with wide mouth, carinated shoulder and footed base.
17. Basin with wide mouth and round base.
18. Vessel with flat base and ovoid profile.
19-22. Jars with carinated shoulder and footed base.

Pl. CLXXXVI A

23. Jar with tapering sides and narrow base. Finger-tip decoration on the shoulder.
24. Jar with flaring rim and ovoid body.
25. As above but without a neck.
26. Jar with prominent flaring rim and carinated shoulder.
27, and 30-32. Jars with flaring or projected rim and round base.
28. Jar similar to 26 but flat base.
29. Jar with carinated shoulder and flat base.

B. Miniature Vessels

Pl. CLXXXVI B

33. Jar with beaked rim, raised neck, bulbous body and a small footed base, wheel-turned.
34, 38, 39, 42 and 43. Variants of the above type. Wheel-turned.
35. S-shaped vessel with flat base, hand-made.
36, 40 and 41. Jars with wide mouth; concavo-convex profile and flat base. Wheel-turned.
37. Basin with flaring rim, hand-made.

Pl. CLXXXVII

45. Bulbous jar with flaring rim and flat base; hand-made.
46. Bulbous jar with a small neck, narrow mouth and pointed base as in the goblet; wheel-turned.
47. As above without a neck, use is flat, wheel-turned.
48 and 50. Jars with wide mouth and narrow footed base; hand made.
49. Goblet with pointed base; hand-made.
51-52. Jars with wide mouth, flaring rim, carinated shoulder and flat base, hand-made.
53. Jar with wide mouth, small neck and a very narrow footed base; hand-made.

C. Miscellaneous

P. CLXXXVIII A-B

54-56 and 58-59. Lids with a flat knob at the top. hand-made.
57. Lid in the form of a jar with carinated shoulder wheel-turned.

60. Suspensory vessel or ornament- hand-made
61. Lid in the form of flower with a conical knob; hand-made.
62-64. Lids with conical knobs or may small spinning tops, hand-made.
65-66- Lids with a bowl-like depression in the centre, hānd made ;
67-71. Bowls with thīck walls, hand made.
72-73. Scale-pans with holes on the margin; hand made.
74-76. Dough plates, hand made.
77. Dish, wheel-turned.
78-79. Small feeding spouted vessels. Similar ones in bronze and silver are in use in Indian homes even now.

9. GRAFFITI (fig. 97).

The scratchings on potsherds are sometimes highly significant if they throw light on the script and names of the owners of the pot or the pot-makers. In the case of potsherds from Lothal it is not possible to make out the names, if any, of the potters or the pot-owners. However some indication of the changes that were being effected in the writing of the Indus people in Period B are hinted by the linear signs inscribed on the potsherds. In all seventy-five potsherds bearing graffiti have been recovered. Three are inscribed before firing. Here only fortyfive sherds are considered as indicating a writing.

Period A.

Linear Signs Figs 96 & 97

Pl. CXCI A

1-2. Red ware. Buff slipped. Post-firing. (fig. 97, *1-2*).
3. Red ware. Post-firing. (fig. 97, *3*).
4. Terracotta 'cake'. Pre-firing. (fig. 97, *4,*).
5. Terracotta tablet. Post-firing. (fig. 97, *5.*)
6. Red-ware. Post-firing. (fig. 97, *6*).
7. Buff-slipped ware. Post-firing. (fig. 97, *7*).
8. Red ware. Red-slipped. Post-firing. (fig. 97, *8*).
9-10. Red ware. Buff-slipped. Post-firing (fig. 97, *9-10*).
11-12. Red ware. Post-firing. (fig. 97, *11-12*).

Pl. CXCI B

13-14. Red-ware. Pre-firing. Some Indus signs have been combined (fig. 97, *13-14*).
15-16. Red ware. Red slipped. Post-firing. (fig. 97, *15-16*).
17. Red ware. Pre-firing. (fig. 97, *17*).
18. Red ware. Red-slipped. Post-firing. (fig. 97, *18*).
19. Terracotta 'cake'. Post-firing. (fig. 97, *19*).

Pl. CXCII

20. Red ware. Red-slipped. Post-firing (fig. 97, *20*).
21-22. Red ware. Red-slipped. Post-firing. (fig. 97, *21-22*).

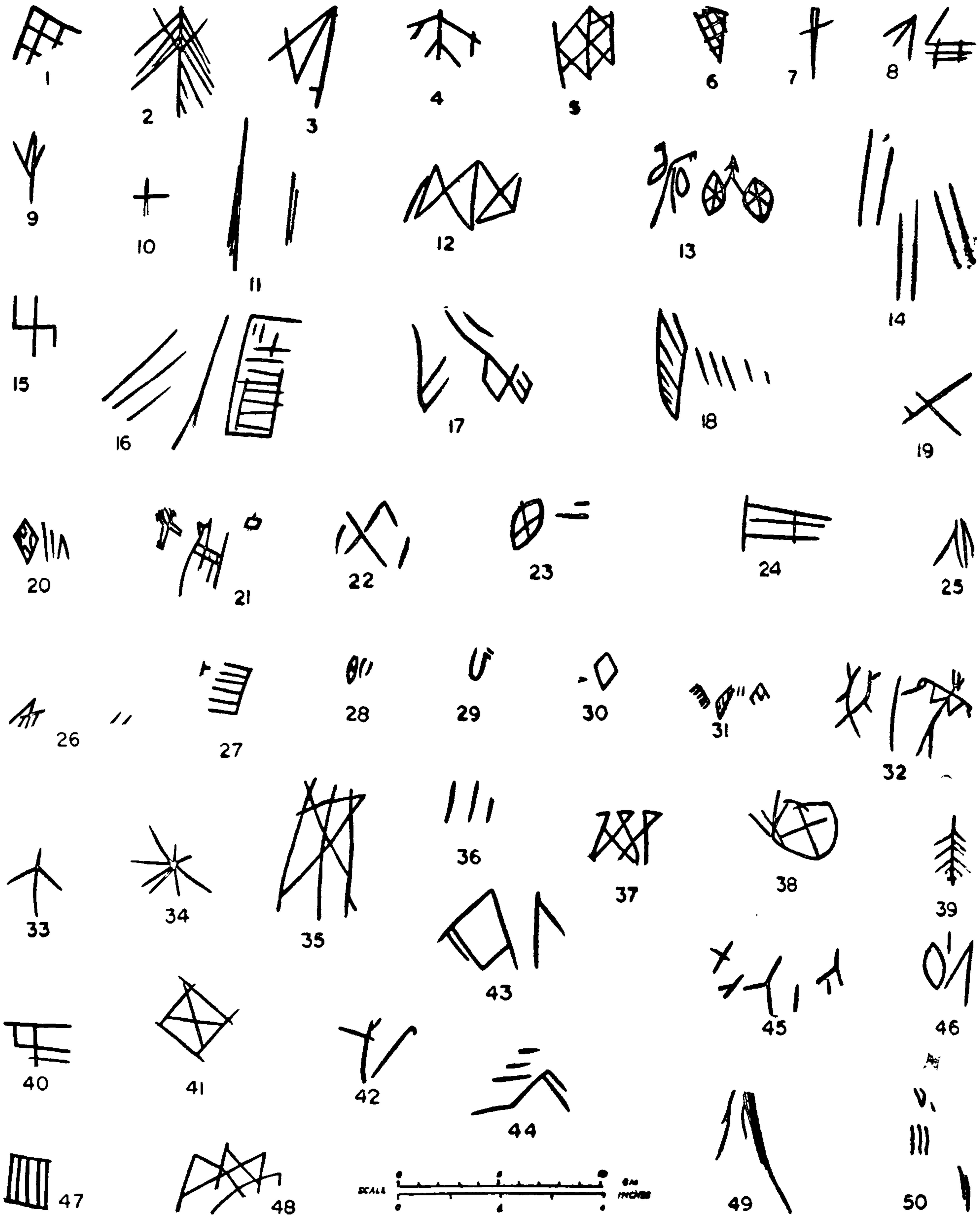

Fig. 97. *Graffiti*

23. Red ware. Post-firing. (fig. 97, *23*).
24. Dull red ware. Post-firing. (fig. 97, *24*).
25. Red ware. Buff-slipped. Post-firing. (fig. 97, *25*).
26. Dull red ware. Red-slipped. Post firing. (fig. 97, *26*).
27. Red ware. Red-slipped. Post-firing. (fig. 97, *27*).
28. Terracotta seal Post-firing. (fig. 97, *28*).
29. Red ware. Post-firing (fig. 97, *29*).
30. Buff ware. ,, (fig. 97, *30*).
31. Red ware. ,, (fig. 97, *31*).

Pl. CXCIII A

32. Red ware. Red-slipped. Post-firing. (fig. 97, *32*).

Pl. CXCIII B

33. Red ware. Red-slipped. Post-firing. (fig. 97, *33*).

PERIOD B.

Pl. CXCIV A

34-43. Red ware. Red-slipped. Post-firing (fig. 97, *34-43*).

Pl. CXCIV B

44-45. Red ware. Red-slipped. Post-firing (fig. 97, *44-45*).

10. REPORT ON POTTERY FROM LOTHAL

By Dr. B. B. Lal, Archaeological Chemist in India

A. General

Sixty-two specimens of pottery from different levels and periods were subjected to a detailed chemical examination and analysis with a view to determining the techniques employed in their fabrication, the nature of raw materials used, the conditions of firing, and the methods and materials used in their composition, technique and decoration. Of these sixty two sherds, 42 have been selected from Lothal A and 20 specimens from Lothal B.

B. Period A. Harappa and Associated wares

(i) *Thick red ware*

Sp; 1 & 2—

These sherds are made of calcareous clay and lime is evenly distributed throughout the body. They represent wheel-made pottery which was fired in an oxidising atmosphere. The surface was finished with a slip of a highly ferruginous clay containing red-ochre. These are very sturdy sherds of fine textured clay and they were subjected to very careful firing with the result that the outer & inner surfaces and the core have all become red due to complete combustion of the organic matter and oxidation of the iron compounds to ferric condition. The thickness of the sherds is considerable, varying from 1.7 cm to 1.8 cm. Fine sand seems to have been used as tempering material. The texture is fine-grained and compact and there are no large voids, showing that vegetable fibres or similar organic material such as grain or cereal husk, mud, or fibrous material was not used as a degraissant.

(i) *Thin red ware*

Sp. No. 3 & 4—

These sherds are made of calcareous clay and the lime is uniformly distributed throughout the body. Both the specimens represent wheel-made pottery which was finished with a thin slip or a wash. Sp. No. 3 was given a slip of finely-levigated ferruginous clay, such as red ochre; Sp. No. 4 was given a thin wash of finely levigated clay containing a much lesser proportion of ferruginous matter which accounts for its buff colour. The sherds were fired in an oxidising atmosphere. A detailed chemical analysis of sherd 3 gives the following results:—

SiO_2	42.47%
Fe_2O_3	8.79%
Al_2O_3	14.58%
TiO_2	traces
MnO	traces
CaO	13.68%
MgO	3.67%
CO_2	8.53%
Organic matter & Alkalies (by diffen.)	8.31%
Total	100.00%

This analysis shows that lime and magnesia account for 17.35% of the clay; carbon dioxide is also present to the extent of 8.53%. It is, therefore, clear that the clay employed for making the pottery was highly calcareous. Fine sand seems to have been used as tempering material. The thickness varies from 0.4 to 0.5 cm.

(iii) *Thick Micaceous red ware (with smoky core)*

Sp. 5 and 6—

Specimen 5 is made of calcareous clay containing medium sand as tempering material; Specimen 6 is also made of the same raw materials. The sherds represent wheel-made pottery which was finished with a slip of finely levigated ferruginous clay. The outer and inner surfaces are distinctly reddish, but the core is grey. The thickness varies from 1.0 cm to 1.2 cm. It seems that chopped straw or vegetable fibre was used as filler or degraissant. The combustion of the organic matter was incomplete and complete oxidation of iron compounds to ferric condition was evidently not possible under these conditions although firing was carried out under oxidising conditions. The grey colour of the core, is, therefore, due to the presence of partly burnt carbonaceous matter and iron compounds in ferrous condition. The ware has been described as micaceous on account of the presence of small flakes of mica on the surface. A detailed chemical analysis of Sp. No. 6 is given below:—

Sio_3	52.52%
Fe_2o_3	9.38%
Al_2o_3	19.77%
Tio_2	traces
Mno	traces
Cao	6.06%
Mgo	2.45%
Co_2	1.00%
Organic matter & alkalies (by diff.)	8.22%
Total	100.00%

From the analysis it is clear that the clay was calcareous. Sherd 6 was evidently painted, as traces of dark colour bands are visible on the exterior.

(iv) *Micaceous red ware*

Sp. 7 & 8—

These sherds are similar to sherds 5 & 6 but they are better made and are not so thick, the thickness varying from 0.4 to 0.6 cm. They represent finely slipped ware and this wheel-made pottery was fired in an oxidising atmosphere. The core of these sherds is, however, buff to cream and not grey showing thereby a complete combustion of organic matter and oxidation of iron to ferric state. Both the specimens show the presence of mica. These sherds seem to have been better made than sherds 5 & 6. Sherd 7 carries two bands in chocolate on the exterior near the rim. Sherd 8 also shows traces of decoration.

(v) *Thick buff ware*

Sp. 9 & 10—

These specimens represent, sturdy thick ware, the thickness ranging from 1.2 cm to 1.6 cm. They are buffcoloured sherds and both the surfaces and the core show the same

colour. They are made of highly calcareous clay, lime being present in an appreciable quantity. The texture is fine-grained and compact, and although the firing was done in an oxidising atmosphere, the red colour of ferric compounds is masked by the lime. Medium to fine sand has been used as a tempering material. Evidence of painting is present on both the sherds. It seems that the painting was done with a manganiferrous earth.

(vi) *Thin buff ware*

Sp. No. 11 & 12—

These sherds are similar to sherds 9 & 10 in texture, colour and composition but they are much thinner, the thickness varying from 0.4 to 0.5 cm. The body of these sherds is made of a highly calcareous clay, lime being present in considerable amounts. These specimens are wheel made and the firing was done under oxidising conditions. A detailed chemical analysis of sherd 12 is given below:—

Sio_2	42.24%
Fe_2o_3	9.25%
Al_2o_3	11.16%
Tio_2	traces
Mno	traces
Cao	19.90%
Mgo	5.01%
Co_2	2.44%
Organic matter & alkalies (by diff.)	10.00%
Total	100.00%

From the analysis, it is seen that lime & magnesia are present to the extent of 24.90% and carbon dioxide is also present in appreciable amounts. Traces of painting are seen on both the sherds. So far as the texture and the compactness of the body are concerned, these sherds are very similar to Sp. 9 & 10. The buff colour of the sherds is due to the bleaching effect of lime, which has masked the colour of ferric compounds.

(vii) *Thick buff-slipped wares*

Sp. 13 & 14—

In texture & composition these sherds are similar to sherds 5 & 6. They are made of highly calcareous clay, lime being present in considerable amounts. The sherds represent wheel-made pottery which was subjected to firing in an oxidising atmosphere. After turning on the wheel the pots were given a surface finish with finely levigated slip composed of a calcareous clay. Due to the presence of a larger amount of lime in the slip than in the body, the pottery has burnt out red with a buff surface which had been slipped. Medium to fine sand was the tempering material, and the firing was done at a high temperature, thus causing a complete combustion of carbonaceous matter. The thickness of these specimens ranges from 0.5 cm to 0.9 cm.

(viii) *Thin buff-slipped wares*

Sp. 15 & 16—

These sherds are similar in texture & composition to sherds No. 13 & 14, but they are much thinner. Their thickness ranges from 0.4 cm to 0.6 cm whereas the thickness of Sp.

13 & 14 ranges from 0.5 to 0.9 cm. The sherds represent wheel-made pottery and a calcareous clay was used for their fabrication. After turning on the wheel, a finely levigated calcareous clay was applied to the surface as a slip. The firing was done in an oxidising atmosphere; the slipped surface burnt out buff whereas the body became reddish. The red colour of the body is due partly to the presence of iron compounds in ferric condition and partly to the presence of a much smaller proportion of lime. The surface of the sherds shows numerous mica flakes. Sherd 16 shows a series of concentric groves which were evidently made with some sharp instrument while the pot was being turned on the wheel.

(ix) *Coarse grey ware*

Sp. 17 & 18:

These sherds are made of a calcareous clay of coarse to medium texture; Coarse sand was used as a tempering material. Although while turning on the wheel, the surface was finished with a slip, the slip was rather thin with the result that it failed to render the surface quite smooth. It seems that a reducing atmosphere was used for firing these wares. Sherd 17 is comparatively better made than sherd 18 which is much coarser in fibric and has a markedly open texture.

(x) *Burnished grey ware*

Sp. 19 & 20—

These sherds represent grey burnished pottery which was fired in a reducing atmosphere. Calcareous clay was used and medium to fine sand was employed as a tempering material. The sherds are much finer and more compact than sherd 17 & 18 and they seem to have been better finished as outer surface of the two sherds was carefully smoothed & burnished. Sherd 19 gave the following composition:—

Sio_2	51.04%
Fe_2o_3	8.40%
Al_2o_3	16.39%
Tio_3	traces
Mno	traces
Cao	12.53%
Mgo	5.01%
Co_2	2.43%
Organic matter & Alkalies (by diff.)	4.20%
Total	100.00%

The chemical analysis shows that a highly calcareous clay was applied for making the pot. As much as 17.54% of the clay is accounted for by lime and magnesia.

(xi) *Black-and-red ware*

Sp. 21 & 22—

These sherds have been described as black and red but the outer surface of both the sherds is reddish and only the rim of sherd 22 is grey, whereas in sherd 21 a grey shade is noticeable near the surface where the convexity is maximum. The interior surface of both

the sherds is dark grey; so is the core. These sherds are made of medium to fine calcareous clay containing appreciable amounts of mica. A slip of finely levigated ferruginous clay was applied to the surface and after finishing the pots, they were subjected to firing in an oxidising atmosphere. The grey colour of the rim and the surface near maximum convexity and on the interior indicates unmistakably that the pots were stacked in the kiln upside down. The inverted firing technique was applied. Chemical analysis of sherd 21 is given below:—

Sio_2	50.26%
Fe_2o_3	8.04
Al_2o_3	15.51%
Tio_2	traces
Mno	traces
Cao	7.14%
Mgo	3.18%
Co_2	7.75%
Organic matter & Alkalies (by diff.)	8.12%
Total	100.00%

From the analysis it is seen that a calcareous clay was employed for making the pot. The thickness of the two sherds varies from 0.4 cm to 0.5 cm.

(xii) *Chocolate-slipped red ware*

Sp. 23 & 24—

The specimens are made of a calcareous clay containing some mica. The clay was fine to medium textured and the tempering material was sand. The sherds were fired in an oxidising atmosphere so that the entire body and the surface of the pots become reddish. The body of the sherd is very compact and fine-grained and the thickness ranges from 0.7 cm to 1.2 cm. After turning on the wheel, the interior surface seems to have been given a slip containing appreciable amounts of a manganiferous earth. The outer surface was given a slip of finely-levigated ferruginous clay; the surface was then painted with a manganiferous earth.

(xiii) *Green-coloured ware*

Sp. 25 & 26—

Sherd 25 has been described as green ware, but it seems that except for a narrow band on the inner surface of the rim, the general colour is grey. Sherd 26 can be described as a yellowish grey. These sherds represent wheel-made pottery; the thickness varies from 0.8 cm to 1.2 cm. A chemical analysis of sherd 25 gives the the following results:—

Sio_2	50.17%
Fe_2o_3	11.35%
Al_2o_3	11.44%
Tio_2	traces
Mno_2	traces
Cao	12.81%
Mgo	5.51%
Co_2	5.60%
Organic matter & alkalies (by diff.)	0.12%
Total	100.00%

From the analysis, it is seen that the sherd is made of a highly calcareous clay containing 18.32% lime and magnesia and 5.60% of carbon dioxide. Medium to fine clay was used for the fabrication of the pot which was given a slip of finely levigated clay containing some lime. The firing was done in a moderately oxidising atmosphere, but the colour did not become red but became yellowish grey on account of the presence of lime. The texture is fine and compact and the ware is well burnt, sturdy and strong.

(xiv) *Coarse red wares*

Sp. 27 & 28—

These specimens are made of a coarse to medium-textured clay containing some lime and mica. Sp. 28 seems to have been hand-made or hand-moulded. It is a rudely-made pot and no attempt has been made to smoothen the surface which is rough and uneven. Sherd 27 is also not very well-made. Their thickness is considerable ranging from 0.8 cm to 1.8 cm. The firing was done in an oxidising atmosphere, but due to the thickness of the pots, the carbonaceous matter could not be destroyed completely during firing, a part of the iron compounds was left in the ferrous condition thus accounting for the grey colour of the pots.

(xv) *Deep black-on-red ware*

Sp. 29—

This specimen is made of a calcareous clay of medium to fine texture. The clay was ferruginous and a small proportions of mica was also present. It represents a wheel made pot which was very carefully finished with a finely levigated ferruginous slip containing a high proportion of red ochre. The exterior surface shows beautiful patterns of painting in dark chocolate pigments. A manganiferous earth was evidently employed as a raw material for obtaining the chocolate pigments used in painting. The pot was very well fired in an oxidising atmosphere so that the surface and the core became red.

(xvi) *White-on-red ware*

Sp. No. 30—

This sherd is about 0.9 cm to 1.0 cm in thickness. The outer surface is reddish, but the core is light grey. A section of the sherd shows three distinct zones; the outer and the inner zones are buff, whereas the intermediate zone is grey. This specimen represents wheel-made pottery which was given a slip of well levigated clay and was fired in an oxidising atmosphere. The clay is appreciably calcareous and glistening flakes of mica are also seen here and there. Medium to fine sand seems to have been used as a tempering material. Traces of painting in red are discernible on the exterior surface of the sherd. It represents sturdy and well fired pottery with a dense compact texture.

(xvii) *Crimson-on-red ware*

Sp. No. 31—

The specimen is made of calcareous clay containing some mica (Muscovite). Medium to fine sand was used as a tempering material. After turning on the wheel and slipping the surface with finely levigated ochreous clay, the pot was allowed to dry. Thereafter the surface was painted using liver red pigment. The pigment has been bound to obtain manganese and iron compounds. It is, therefore, evident that a mixture of an ochreous

clay and a manganiferous earth was used for painting. It was fired in an oxidising atmosphere and a section of the sherd shows three distinct zones, the outer and the inner zones, being red and the intermddiate zone light grey. In texture and fabric, this sherd is very similar to sherd 30 already described.

(xviii) *Black-on-micaceous red ware*

Sp. No. 32—

This specimen is made of calcareous clay with fine sand as tempering material; glistening flakes of white mica (Muscovite) are seen here and there on the surface of the sherd. After turning on the wheel and slipping with finely levigated clay on the exterior, the pot was allowed to dry. Thereafter the exterior surface was decorated by paintings in dark chocolate or black colour. The pigment seems to have been made of a manganiferous earth. The firing was done in an oxidising atmosphere. The thickness of the sherd varies from 0.3 cm to 0.7 cm. In colour, texture and composition this sherd is similar to sherd 30 but it has a much smaller thickness.

(xix) *Chocolate-on-buff ware*

Sp. No. 33—

This sherd represents a thick sturdy buff ware, the thickness ranging from 0.8 cm to 1.1 cms. It is made of fine clay containing some lime. Fine sand may have been used as a tempering material. The pot was made on the wheel, and the surface is slipped with finely levigated clay of a similar composition with the result that the slip and the body have burnt out uniformly and there is no line of demarcation between the two. The pot was decorated with wide concentric bands in chocolate colour; the pigment was a manganiferous earth. The pot was well fired in an oxidising atmosphere.

(xx) *Red-on-buff ware*

Sp. No. 34—

This sherd represents a finely made pot and its thickness varies from 0.4 cm to 0.7 cm. The clay used for making the pot was calcareous and only fine sand was used as a tempering material. After turning on the wheel the pot was finished with the same calcareous clay which was used for the body. The ware was fired in an oxidising atmosphere so that the entire pot has become reddish buff and a section of the sherd shows a uniform colour without distinctly coloured zones. The exterior of the pot was painted in red and chocolate and it seems that the pigments used in painting were obtained from red ochre and a manganiferous earth.

(xxi) *Black-on-bichrome ware*

Sp. No. 35—

This sherd is made of calcareous clay containing coarse to medium sand as temper. It seems that some vegetable fibrous material was also used as a degraissant. After turning on the wheel the pot was given a thick slip which probably did not cover the pot uniformly. The greater part of the outer surface is distinctly buff, a whitish buff, and only a small portion of the surface is reddish. The inner surface is red through out and is markedly rough and uneven. The painting has been done in dark chocolate or black pigment composed of a manganiferous earth. The thickness of the sherd varies from 0.8 cm to 1.1 cm and a

section shows three distinct zones, the outer and the inner zones being red and the middle zone being grey. The pot was fired in an oxidising atmosphere. In texture and fabric this sherd is much coarser than sherds 30, 31, & 33.

(xxii) *Black-on-coarse red ware*

Sp. No. 36—

The sherd is made of fine calcareous clay containing numerous glistening flakes of white mica and medium to fine sand as tempering material with thickness varying from 0.6 cm to 1.0 cm. In section, it shows a uniform reddish colour without any markedly defined zones. The core is, however, slightly darker in shade than the surface. After turning on the wheel, the pot was given a slip of the same clay as the body, and finally it was given a wash of red ochre both on the exterior and the interior. The pot was fired in an oxidising atmosphere. It was painted on the exterior in black to dark chocolate colour. The inner surface of the rim was also painted in the same colour. A manganiferous earth was used for the pigment. The sherd is much finer and denser in texture and finish than sherd No. 35.

(xxiii) *Chocolate-on-green ware*

Sp. No. 37 —

This sherd is made of coarse calcareous clay, medium to coarse sand being the tempering material. In section, the thickness varies from 0.5 cm to 0.7 cm and it shows two distinct zones the upper exterior zone being dark grey and the lower interior zone being pale grey. After turning on the wheel, the pot was given a thick slip and later on the exterior surface was painted in chocolate colour. The greyish green colour of the surface is quite distinct from the pale grey colour of the inner surface. The pot seems to have been fired in a limited supply of air and the carbonaceous matter and iron compounds could not get completely oxidised. It gives a metallic ring when struck and is evidently well fired. The pigment was prepared from a manganiferous ore.

C. Foreign Wares

(i) *Second slip*

Sp. No. 38—

The sherd is made of a calcareous clay with sand as tempering material. In section its thickness varies from 0.6 cm to 0.9 cm. No distinct zones are seen in the section, but there is only one uniform colour throughout the thickness. After turning on the wheel, the surface was given a slip of finely levigated clay, the composition of which was similar to that of the clay, employed in making the pot. After the slip had dried, a protion of the pot was given a wash of red ochre on the exterior with the result that the outer surface of the pot became partly deep red and partly buff. The firing was carried out in an oxidising atmosphere and designs in black colour were painted for decorating the pot. The black colour shows the presence of manganese; evidently a manganiferous earth or ore was used for the preparation of the pigment. This specimen does not indicate the use of the reserved slip technique, since there is the hidden buff slip. There is no doubt that part of the post was coloured with red ochre wash, and part of it was left unwashed with its original buff colour.

(ii) *White-on-black ware*

Sp. No. 39—

This specimen is made of fine calcareous clay containing glistening flakes of white mica. The outer surface of the sherd is deep red and smooth; the inner surface is black and smooth. After turning on the wheel, the outer surface was rendered smooth by burnishing. The outer surface was given a wash of red ochre or probably, this surface was burnished with a haematite pebble, thus producing not only a deep red ochre colour but also rendering the surface very compact, dense and smooth. The inner surface is deep black and is quire smooth. There are no traces of any white pigment on the inner black surface but impressions of some design comprising parallel streaks of varying width (1 mm to 2 mms) are discernable. In the absence of traces of the white-pigment, its chemical nature cannot be determined, but there is no doubt that some sort of decoration was carried out on the exterior surface. A section of the sherd shows two distinct zones, the upper exterior zone being red and the lower interior zone grey to black. The outer red zone is much smaller in thickness than the inner greyish black zones the total thickness of the sherd ranging from 0.3 cm to 0.5 cm. The pot was fired in a oxidising atmosphere; but its interior was rendered black probably by stuffiing it with carbonaceous matter or placing it up side down in the kiln, so that iron compound on the present inner surface escaped oxidation but were reduced to greyish black ferrous compounds.

(ii) *Chocolate-on-buffish vellow ware*

Sp. No. 40—

This sherd of buff colour is made of a coarse calcareous clay containing coarse sand as a tempering material. The texture of the sherd is open and coarse, and the section shows numerous pores indicating that some organic material such as straw or vegetable fiber has been employed as a degraissant. After turning on the wheel, the pot was given a slip of the same clay as was used for making the body. A section of the sherd shows a uniform buff colour throughout, and varies in thickness from 0.5 cm to 0.6 cms. The exterior surface carries paintings in chocolate to black colour. Themical analysis of the pigment shows the presence of iron and manganese. A manganiferous earth was the source of pigment employed in painting. The pot was well burnt at a fairly high temperature. In texture, colour and composition this sherd is entirely different from the other sherds described earlier.

(iv) *Black-on-pink ware*

Sp. No. 40(A)—

This sherd is also as coarse as sherd No. 40 but it is reddish in colour with a thickness ranging from 0.5 cm to 0.6 cm. In section it shows two distinct zones, the upper outer zone being reddish and the lower inner zone being greyish, the inner surface being brick red. It is made of a coarse calcareous clay with coarse sand as a tempering material. After turning on the wheel, the surface was given a wash of finely levigated clay. This surface has burnt out pinkish buff, and it was painted in chocolate colour using a manganiferous earth as a pigment. An oxidising atmosphere was employed during fire. A chemical analysis of the body of the sherd gave the following results:—

Sio_2	46.38%
Fe_2o	15.80%
Al_2o_3	17.90%
Tio_3	traces
Mno_2	traces
Cao	9.30%
Mgo	2.68%
Alkalies & organic matter (by diff.)	5.95%
Total	100.00%

From the analysis it is seen that a calcareous clay containing 11.98% of lime and magnesia was employed for making the pot.

(v) *Reserved slip wares*

Sp. No. 40(B)—

This specimen is made of a fine textured calcareous clay. Particles of lime are seen distributed discretely in the clay. In section the thickness varies from 0.7 cm to 0.8 cm and its colour is reddish throughout ; there are no indications of distinctly coloured zones except for a faint greyish intermediate zone. The sherd represents a dense compact fine-grained ware which was fired in an oxidising atmosphere after the ware had been given a thin slip or wash of red ochre and a white slip thereon. This ware indicates the use of reserved slip technique, since the uppermost whitish slip had been partly removed with a comb-like instrument producing a wavy pattern and exposing the red underlying ochreous wash. Since the underlying wash has been exposed by removing the overlying wash or slip, the ware should be described as Reserved Slip Ware. This sherd is quite distinctive, as the style of decoration employing the reserved slip technique has not been detected in any other case.

D. Pottery From Period B

(i) *Red ware*

Sp. No. 41 & 42

These specimens are made of clay containing small proportions of lime. In section, the thickness of sherd 41 varies from 0.9 cm to 1.1 cm and it shows three distinct zones, the inner and outer zones the inner and outer zones being reddish in colour and the intermediate zone being grey. The other specimen No. 42 varies in thickness from 1.0 cm to 1.4 cm. It also shows three distinct zones, the two outer zones being reddish and the middle zone being greyish. Fine textured clay seems to have been used in making these pots. After turning on the wheel, a slip of ochreous clay was applied and designs in chocolate colour have been painted on sherd No. 42. The pigment represents a manganiferous earth. These two sherds 41 & 42 are somewhat inferior in technique and manifestation to sherds 1 & 2 of Lothal (A) but the decoration in chocolate colour is absent in the latter (1 & 2). A detailed chemical analysis of specimen No. 41 gave the following results:—

SiO_2	51.20%
Fe_2O_3	10.53%
Al_2O_3	11.98%
TiO_2	traces
MnO_2	traces
CaO	7.60%
MgO	4.24%
CO_2	3.01%
Alkalies & organic matters by difference	11.44%
Total	100.00%

(ii) *Coarse red ware*

Sp. No. 43 & 44—

Specimen 43 is made of a calcareous clay with coarse sand as tempering material. A section of the sherd shows discrete particles of lime and sand disseminated throughout the body. The specimen 43 varies from 0.5 cm to 0.8 cm in thickness. It was made on the wheel and the outer surface was given a slip of finely levigated clay containing a considerable proportion of red ochre. It was fired in an oxidising atmosphered. Specimen 44 is made of a calcareous clay containing some mica. This sherd is slightly finer in texture than sherd 43. After turning on the wheel, it was given a slip of ferruginous clay and fired in an oxidising atmosphere. The sherd does not show a bright red slip which characterises sherd 43.

(iii) *Buff Ware*

Sp. No. 45 & 46:

These specimens are composed of highly calcareous clay which was fine-grained and lime and fine sand are uniformly distributed throughout the body of the sherd. Sherd No. 45 shows three distinct zones, the two outer zones being reddish and the intermedicate zone being pale greyish. After turning on the wheel, specimen 45 was given a thick slip of clay containing a considerable proportion of lime. The inner surface was also given a similar surface treatment. The slip has burnt out yellowish buff in the oxidising atmosphere of the kiln. The buff colour is due to the presence of lime. Sherd 46 shows a greyish core with a thin outer zone of reddish colour. The outer surface of this ware is reddish throughout. After turning on the wheel the pot was given a wash of a ferruginous clay and then fired in an oxidising atmosphere. The paintings in chocolate brown are still noticeable on the exterior surface. A manganiferous ore and red ochre were used for painting. A detailed chemical analysis of sherd No. 45 is given below:—

SiO_2	52.81%
Fe_2O_3 } Al_2O_3	22.34%
TiO_2	traces
MnO_2	traces
CaO	14.28%
MgO	5.77%
CO_2	2.69%
Alkalies & organic matters (by difference).	2.11%
Total	100.00%

From the analysis, it is seen that lime and magnesia are present to the extent 20.05%. This high proportion of lime and magnesia accounts for the yellowish buff surface of the sherd.

(iv) *Buff-slipped red ware*

Sp. No. 47 & 48—

These specimens show the presence of calcareous clay with some white mica. After turning on the wheel they ware given a thin slip of finely levigated clay containing lime. It is quite likely that a yellow ochreous calcareous clay was used for the preparation of the slip. The firing was done in an oxidising atmosphere, so that the body became red and the slip became yellowish buff due to the bleaching effect of lime. Both the sherds represent very fine textured clay, with fine sand as tempering material. It is probable that a small proportion of vegetable fibrous material has been used as a degraissant.

(v) *Green-coloured ware*

Sp. No. 49 & 50

These sherds are made of calcareous clay; the clay is poor in iron. The clay was fine textured and medium to fine sand was used as tempering material. Some vegetable fiberous material was probably used as filler or degraissant. Sherd No. 49 represents a thick, sturdy ware, thickness ranging in section from 1.7 cm to 1.9 cm. It was turned on the wheel and a slip of highly ferruginous clay was employed for rendering the exterior surfaces smooth. Sherd No. 50 also represents pottery turned on the wheel. A slip of the same composition as the body was employed in this case, and in section the sherd shows uniform colour and texture through out. Its thickness varies from 0.8 cm to 0.9 cm. The yellowish buff colour of this sherd is due to bleaching effect of the line which has marked the red colour of ferric compounds formed in the oxidising atmosphere of the kiln. These sherds do not show any distinct green tinge but are yellowish buff in colour.

(vi) *Black-and-red ware*

Sp. No. 51 & 52—

These sherds are made of calcareous clay; fine sand was used as tempering material. It is probable that choffed straw and vegetable fibres may also have been used as a filler or degraissant. After turning on the wheel a slip of finely levigated clay was applied to the entire surface, both inner and outer. The outer surface seems to have been subjected to burnishing and the firing was done in a reducing atmosphere which probably changed to an oxidising one towards the end. It seems that inverted firing technique was employed. Evidence of painting is quite distinct on the exterior surface of specimen No. 51. Probably a chocolate or brown pigment was used in painting.

(vii) *Red-slipped buff ware*

Sp. No. 53 & 54—

These specimens are made of calcareous clay similar in composition to sherds 49 & 50. The clay was calcareous and lime was present in appreciable quantities. Sand was used as tempering material and after turning on the wheel a slip of a ferruginous clay was applied for finishing the inner and outer surface. The firing was done in an oxidising atmosphere. The red colour of the surface is due to the oxidation of ferric compounds.

The pots were painted with a chocolate colour and the pigment was probably derived from a manganiferous ore. A complete chemical analysis of specimen No. 54 is given below:—

Sio_2	49.41%
F_2eo_3	9.78%
Al_2o_3	14.85%
Tio_2	traces
Mno_2	traces
Cao	13.15%
Mgo	8.94%
Co_2	5.77%
Alkalies & organic matter (by difference)	3.10%
Total	100.00%

From the analysis, it is seen that the clay contains 17.09% of lime and magnesia and this accounts for the grey colour of the body.

(viii) *Coarse grey ware*

Sp. No. 55 & 56—

Both the specimens are made of coarse-textured clay containing gravel and calcareous sand ast he tempering material and carbonaceous matter as degraissant. After turning on the wheel the surface was given a slip of ferruginous clay. It is probable that the inner surface of Sp. 55 was subjected to burnishing before firing in the reducing atmosphere. This accounts for black shining inner surface of specimen 55. Specimen 56 shows the results of incomplete firing. The core is entirely black and the outer surface is red. The inner surface is only greyish brown.

(ix) *Burnished grey ware*

Sp. No. 57 & 58—

These specimens represent fine grained pottery which was turned on the wheel and finished with a smooth slip of finely levigated ferruginous clay. Specimen number 58 has been found to contain a considerable proportion of lime. The firing was done in a reducing atmosphere, but in the case of specimen 57 probably the atmosphere became oxidising towards the end of firing, thus producing a reddish colour on its exterior surface.

(x) *Black-on-red ware*

Sp. No. 59—

This specimen is made of calcareous clay; medium to fine sand was used as a tempering material. After turning on the wheel, the ware was given a slip of finely legivated ferruginous clay which burnt to a red colour in the oxidising atmosphere of the kiln. The painted designs on both the surfaces have been done in chocolate to brownish black colour using a manganiferous earth as pigment. Complete chemical analysis of this sherd is given below:—

SiO_2	50.45%
Fe_2O_3	10.64%
Al_2O_3	13.50%
TiO_2	traces
MnO_2	traces
CaO	15.20%
MgO	4.07%
CO_2	2.93%
Alkalies & organic matters (by difference)	3.75%
Total	100.00%

From the analysis it is seen that lime and maganese represent 19.27% of the clay.

(xi) *Chocolate-on-green ware*

Sp. No. 60—

This specimen is similar to specimen 49 in texture in composition and colour. It is made of fine textured clay containing a fair proportion of lime. After turning on the wheel, and slipping the surface, both inner and outer with finely levigated clay of the same composition as the body, it was very well fired in oxidising atmosphere. Paintings in chocolate colour are seen on the exterior and for such surface decoration a manganiferous earth was used.

CHAPTER XVIII

TERRACOTTA OBJECTS

1. INTRODUCTORY

Terracotta objects, like pottery, throw valuable light on the occupations, artistic achievements and religious beliefs of the people. This is true of Lothal also which has yielded more than three thousand terracotta objects excluding bangles. Owing to the extreme scarcity of stone, baked clay served as a substitute wherever possible. Slingballs, loom-weights and fish-net weights were also made of baked clay instead of stone. The poor man had to satisfy himself with ornaments made of terracotta, as metals and gemstones were very expensive. Another reason for preferring clay to stone is that it is a suitable medium for the modeller to exhibit his artistic urge in shaping human and animal figures, personal ornaments and toys.

A. Material

In ancient times it was regarded as essential that mother earth should be the material used for figures of mother-goddess. Even now clay figurines are considered more sacred than those of metal for worship on festive occasions. Clay is cheaper and easier to model or mould. Whatever be the reason, the Lothal folk used buffish alluvial clay mixed with mica for modelling figurines. This material when combined with sand as degraissant can stand high temperature.

B. Firing

In general all terracatta objects are well-fired and resist water-action. Human figurines are better fired than some of the animal figurines, most of which were used as toys and perhaps baked at home. A small kiln of the type noticed in Block 'E' near the Acropolis might have been used for baking small objects without bringing them directly in contact with fire or smoke.

C. Slip

It is only in a few cases that the traces of a red slip applied after firing is seen. The female figurines were invariably treated with a red slip. According to Mackay red slip is said to have been associated with the fertility cult, but it is noticed in the case of animal figurines also at Lothal. Occasionally a buff or chocolate slip was used, but cream is extremely rare. In the Indus Valley however cream, red and chocolate were frequently used.

[1] Mackay *op. cit.* 1938, I, p. 259.

[2] *Ibid* II, pl. LXXIII, *7;* LXXVII, *10* and *12;* LXXIV, *5;* LXXX, *27.*

D. Decoration

Burnishing was rarely resorted to as a mode of decoration of figurines in the Indus Valley or Lothal. Occasionally a smooth surface was produced by the application of a fine thick slip. The applique decoration noticeable in the Indus Valley figures in the form of collar bands, garlands and pellet-eyes is conspicuous by its absence in the terracotta human figurines from Lothal and Rangpur. None of them wear any other ornament such as bangle or wristlet. Female figures do however have applique breasts and in one case applique eyes also. But the Lothal figurines are more realistic and better proportioned than the Indus Valley terracottas.

E. Types

The terracotta objects from Lothal can be divided into six broad categories:—

1. Human and animal figurines.
2. Personal ornaments.
3. Tools and weapons.
4. Household objects.
5. Toys and gaming pieces and
6. Miscellaneous objects.

In the first group human figures are very few; animal figures are numerous. The second group which includes personal ornaments such as bangles, rings, beads, pendants, ear- nose and head ornaments accounts for the bulk of terracotta objects. The third group includes plumb-bobs, crucibles and moulds, spindle-whorls, spools, loom weights and net-sinkers. The fourth group comprises of the ladle, lamp, lid and jar-stopper. The fifth group consists of toys such as carts and boats, tops and marbles, gaming boards, gamesmen and wheeled birds and animals. Other miscellaneous objects included in the last category are sling ball, triangular cakes and other miscellaneous objects of indeterminate use. Earthenware, terracotta seals, sealings and beads are separately described in the relevant chapters.

2. HUMAN FIGURINES.

The total number of human figurines found at Lothal is only 13. There is no convincing evidence to show that a cult involving the token offer of terracotta figurines and their multiation after the ceremony was over, ever existed at Lothal. Although the human figur-ines-in-the-round are rare in Kathiawar it must, however, be said to the credit of Lothal artists the few figures that they made are realistic and well-modelled.

Most of the figurines were hand-modelled but the use of mould was certainly known to the Lothal folk as is evident from a moulded figurine of tiger (below p. 485) and a hollow head of a ram. The details of animal figures suggest that anatomy was well known to the Harappan modellers.

Usually the mother-goddess figures from Harappa and Mohenjo-daro are found to be wearing a curious variety of fan-like head-dress while the female figurine from Lothal vaguely resembling the Kulli-Mehi figurines[1] has a less ambitious head-dress in the form of a pinched band of clay. The absence of any indication of the apparel and the emphasis on the breast and navel indicate nudity of human figures in general, but in the

[1] A Stein *An Archaeological Tour in Gedrosia, Memoir of the Archaeological Survey of India,* 43, Calcutta 1931 pls. XXII and XXXI.

(no. 6734) with broad shoulders, rounded arms, slim waist and applied breasts may be taken as a good example of art-in-the round. Among crudely worked figures is what may be a Mother-Goddess (no. 9928) because of the prominent breasts and a projecting head-dress indicated by pinched clay. The nose is also pinched, but the applique eyes have fallen off. The mouth is not indicated clearly. The pedestal base and prominent breasts of the figure suggest greater affinity with the clay figurines from Kulli[1] than with those from Mohenjo-daro and Harappa. The crudest of all the female figurines from Lothal is one with prominent breasts, small pinched head, beaked nose and slit mouth (no. 5416). It has no limbs. Such crude figures, both male and female, are reported from Tepe Gawra[2] also.

Generally speaking the terracotta human figuries from Lothal show fewer details than the Indus Valley terracottas. The female figures are well-proportioned and the anatomical features are clearly brought out. Surprisingly enough the Mother-goddess figures are extremely rare.

Pl. CXCV A

Sumerian head; light-red, well baked; sharp pointed nose, sunken eyes indicated by incisions in the depressions; prominent square-cut beard and bald head indicating Sumerian influence. From phase III, Period A. (No. 7581). Vaguely resembles a figure from the sargonid levels of Brak.[3] Fig. 98, *1*.

Pl. CXCV B

Mummy; brick-red; Eyes and mouth indicated by blind perforations. Suggestive of a figure wrapped up in a coffin with its face uncovered. From phase II, Period A. (No. 5096).

Pl. CXCV C

Composite figure with human body and horse head; red slip; ill-baked. Head of a horse or bear with slit mouth, incised nostrils and eyes and small projections suggesting ear, sloping shoulders, separated arms, short legs and disproportionate body. From phase IV, Period A. (No. 12530) Fig. 98, *2*.

Pl. CXCV D

Torso of a male red; ill-baked; separated arms; well-formed belly and buttocks; finger impressions visible on the body. From phase III, Period A. (No. 5980).

Pl. CXCVI A

Torso of a male, buffish in colour; ill-baked; prominent belly with the navel indicated by a blind hole. Hole between the thighs meant for holding the figure on a stick for taking out in procession. Moderately baked; damaged. From phase III, Period A (No. 3300).

Pl. CXCVI B

Upper part of a figure; dull red and ill-baked; thick neck; pellet eyes fallen from sockets; beaked nose; mouth indicated by depression; broad shoulders and chest; arms separated but broken. From phase III, Period A (No. 7455). Fig 98, *7*. Occurs at Mohenjo-daro also.[4]

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[1] Stein, *op. cit.* 1931.

[2] Tobler, *op. cit.* 1950, pl. LXXXIVb.

[3] Mallowan *op. cit.* 1947, pl. XLIII.

[4] Mackay *op. cit.* 1938, II, pl. LXXVI, *15*.

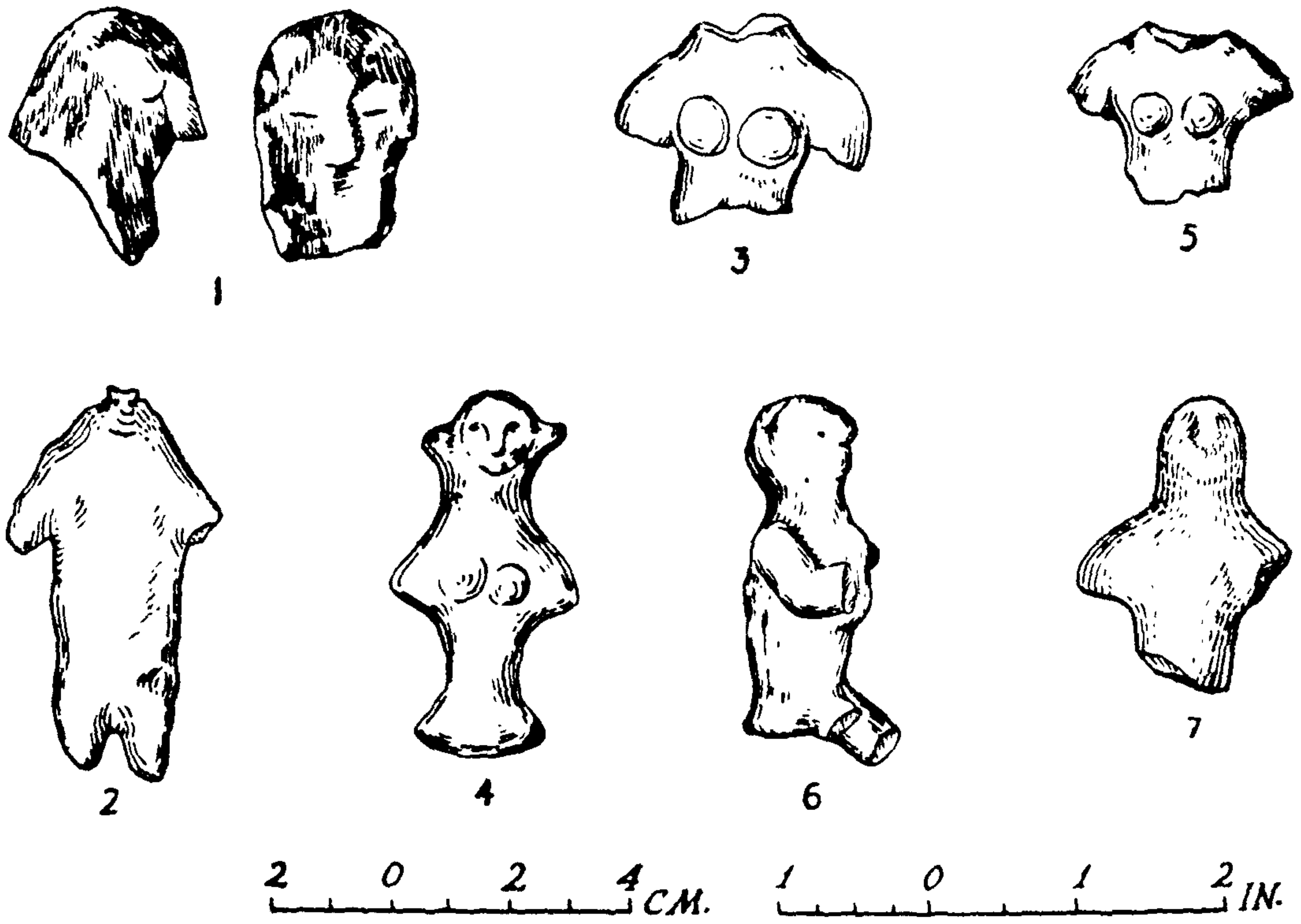

FIG. 98. *Terracotta human figures*

Pl. CXCVI C

Bust of a female; brown in colour and moderately baked; very small head; beaked nose: slit mouth and prominent pinched breasts. From phase III, Period A (No. 5416). Occurs in Al'Ubaid levels at Ur and in Khafaje.[1]

Pl. CXCVII A

Female torso; dull red; moderately baked separated and well-proportioned arms; applique breasts and narrow waist; Moderately baked; damaged. From phase III, Period A (No. 6734) Fig. 98, *5*.

Pl. CXCVII B

Female torso; chocolate-slip on buff surface; well baked: elegant body, broad chest, separated and proportionate arms; limbs damaged; applique breasts fallen off. A good example of art-in-the-round. From phase III, Period A (No. 6681). The mother-goddess figurines from Tepe Gawra. Stratum XVIII—XIX[2] bear close resemblance to this figure.

Pl. CXCVII C

Female torso; chocolate-slip on buff surface; well-baked; proportionate and separated arms but broken; well formed waist; applique breasts fallen off; arms and legs damaged; From phase IV, Period A (No. 10076). Resembles the mother goddess figure from Tepe Gawra-. Fig. 98, *3*.

Pl. CXCVII D

Female figure; buff-slipped; well-baked; flat pate, prominent pinched nose; eyes and mouth indicated by depressions; pinched clay knobs round the head probably indicating head-dress; thick neck; low shoulders, separated arms; prominent pinched breasts and narrow waist; concave pedestal base. Perhaps represents mother goddess. Crude. From phase II, Period A (No. 9928). Fig. 98, *4*. Differs from the mother goddes figurines of the Indus Valley but resembles the female figurines from Kulli[4] except for the ornamention which is not to be seen on Lothal fig.

Pl. CXCVIII A

Gorilla; red and moderately baked; small pinched head and human body with a prominent belly, short pressed arms, dwarfish legs, and slit mouth; large appendages to the buttocks. Crudely modelled. Unstratified, Period A. (No. 9565).

Pl. CXCVIII B

Leg; of a human figure, buff in colour and ill-baked; From phase III, Period A (No. 1513).

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[1] Leonard Woolley, *Ur Excavations* IV, 1950 pls. 21 and 22.

[2] Tobler *op. cit.* 1950, pl. LXXXId.

[3] *Ibid.*

[4] S. Piggot, *Prehistoric India* (London 1961) fig. 9.

3. ANIMAL FIGURES

A. Technique and Use

Terracotta animal figures must have been used as toys, but it is not certain whether they were used as votive objects also. Among the animal figures the bull was the most popular at Lothal where 74 specimens are recovered. Next in popularity is the dog, of which 34 specimens are found. Two figures each of rhinoceros and pig and one each of unicorn, elephant, tiger, spotted leopard (?), bear, ram and squirrel are also found. Among other animal figures of importance are the cow and the horse. No other Harappan site has yielded any model of cow, though one is said to have been represented on a circular Indus seal found at Ur.[1] The absence of teracotta figures of cow in the Indus Valley is said to suggest that the Harappans did not hold the animal sacred, but, with the occurrence of two figuries at Lothal, this argument fails. Similarly the occurrence of terracotta figuries of horses at Lothal and Rangpur clearly indicates that the horse was known to the Harappans.

Several terracotta animal figurines are mutilated. This mutilation is sometimes attributed to the cult of Mother-Goddess involving the offer of animal figures as votive objects. Figures of bull are said to have been used as votive offerings to the Mother Goddess at Kulli, Mehi etc.,[2] this cannot be said of Lothal where the Mother Goddess cult was hardly known.

The present day Kankrej-breed of cattle from Kathiawar closely resembling the bulls represented on the seals from the Indus Valley does not occur in Lothal A but occurs in Lothal B and Rangpur III. None of the Lothal seals bears this motif. It is, therefore, possible that the Brahmani bull came to Kathiawar in the Late Harappan Period by which time it appears to have almost disappeared from the Indus valley.

Like human figures the animal figures from Lothal are also mostly hand-modelled. The only instance of moulding is the figure of a tiger (no. 2014) taken from a double-mould. Unfortunately only one half of the animal has been recovered. The majority of the animal figures are realistic. Those which are crude may be considered to be the hand-work of children.

Generally speaking, terracottas were better fired to a brick red colour and are sturdier in the earlier phases of period A than in the later. The figures which are black in colour appear to have been fired under reducing conditions. Such figures are rare.

Decoration in the form of nail-punch marks is seen on a bull and unicorn (pl. CCVIc). A pointed nail or thorn was used for making sharp incisions for this purpose.

Painting animal figures was another form of decoration but it was rarely practised. There are only two instances namely a painted horn and an animal figure from the late Harappan levels at Rangpur[3] to indicate that the practise of painting figures was not unknown to the Harappans.

The usual way of indicating mouth is by a slit, the nostrils by perforations and the eyes by pellets with dowel-holes or direct incisions. Horns are shown by pinching the clay up, which may be mistaken sometimes for ears if they are not found in their proper position. In the case of bulls the dewlap has been shown occasionally by pinching the clay and bringing out a thin sheet, while in the case of the rhinoceros the folds of the skin are indicated by strips of clay. It must however be noted that in many instances the details of the mouth, eyes and nostrils have been obliterated. Normally, the legs are formed by pinching

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[1] Gadd. *op. cit.*, 1932 pl. III, *18*.

[2] Stein *op. cit.* 1931 p. 92.

[3] S.R. Rao *op. cit.* 1963, p. 138, pl. XXXI A, *6*.

clay and in rare cases they are attached separetely with a thin pointed stick. This can be made out from the blind holes in the undersurface of the body of the figures. Whenever the animal was meant to be wheeled, the legs were joined in pairs and transverse holes made at the ends to fix the wheels. A few figurines have a pedestal base, but are not wheeled. The applique eyes and tail are missing in a large number of animal figures.

Most of the animal figurines found at Lothal represent the domesticated variety such as the bull, cow, dog, pig, horse, ram etc. The elephant which appears to have been domesticated by the Lothal folk was valued for its ivory. Other beasts represented are the tiger and leopard.

B. Unicorn

Among the terracotta animal figures recovered at Lothal, the head of a unicorn is interesting. Hitherto it was believed that the animal engraved on the Indus seals was mythical and never existed in reality, but the occurrence of a realistic animal-head with a single curved horn projecting from the forehead may suggest the existence of the species *unicornis* in India. The Lothal specimen has a medium-sized snout and laterally projecting ears. The neck is decorated by nail-punch marks and the eyes pellets have fallen off.

C. Bull

Bull was the most popular animal at Lothal where seventy four terracotta figures of the humped and humpless varieties have been found. Several more damaged models may also represent the bull. It is fairly evident that the Brahmani bull with its long horns, prominent hump and dewlap did not find favour with the Lothal folk and is not therefore represented on the seal. Only two terracotta figures of this variety (fig. 99.2) have been found in the excavations. The humped bull was known in Syria in 1000 B.C. and much earlier in Egypt, about the time of the Eighteenth Dynasty. The humped cattle is said to have made its way from Elam to Egypt via Anatolia and Syria while Marshall holds that their original habitat was India, from which country they were introduced into Elam at a very early date.[1] Clay figures of cattle were found by Sir Aurel Stein in the protohistoric sites of northern and southern Baluchisthan.

D. Dog

Among the pets maintained by the Harappans the dog occupied an important place. It was useful in hunting and guarding the herds of cattle and sheep. Lothal has yielded a larger number and variety of terracotta figurines of dog than any other Harappan site. The majority of them are crude and therefore presumed to be the hand-work of children. A few figurines are however realistic,

Three distinct breeds of dogs, namely, the common pariah dog (pl. CCII B), the mastiff (pl. CCII C) and the hound can be made out. It is not possible to identify other breeds for want of details. The pariah dog can be made out from its short legs, erect tail, short snout and almost prick-ears. The eyes and nostrils are shown by incisions and the mouth by a slit (No. 11887). Some models have drooping ears. too. Similar figures of dogs with long face, upright tails and prick-ears found at Mohenjo-daro are said to resemble an ancient Egyptian breed such as the one depicted on the knife-handle of Gebel-el-Arak.[2]

[1] Marshal *op. cit.* 1931, I, p. 348.

[2] Sir Flinders Petrie; *Prehistoric Egypt* (London 1920), pl. XXXVI, *62.*

On the proto-Elamite sealings too similar figures with a long face, prick-ears and erect tail, can be seen. Two of the Lothal specimens are excellent examples of the Indian pariah dog and bear close resemblance to those from Egypt and Elam.

A miniature model of dog (pl. CCII A *10*) has an erect-tail, prick-ears, short legs and a snout. The collar is considerably damaged. Another specimen has a transverse hole and the front legs are joined. The nostrils are indicated by incisions and the ear by pinched clay. It must have been one of those toys which could be held by a stick passing through the transverse hole and manipulated with string. Mention may also be made of another roughly worked model of a small dog with long legs, curved tail and long snout. The mouth is indicated by a slit.

The mastiff shown in a running posture has a fierce look and sturdy body (No. 5042). The profuse growth of hairs over the head is indicated by pinched clay. Probably mastiffs were also kept as pets and used rarely for hunting.

The hound has a long snout and is of sturdy build (No. 8440). The applique eyes, lop ears and deeply silt mouth are also clearly seen, but other parts are damaged.

E. Horse

The most controversial among the animals known to the Harappans is the horse, for, once it is admitted that the horse was known to the Harappans, it demolishes an important argument against the Harappans being non-Aryans. The Aryans are said to be excellent riders and knew horse-breeding. They enjoyed horse and chariotraces. The animal was revered and also used for drawing chariots and carrying loads. Their easy victory over the non-Aryan tribes is attributed to the use of the horse-drawn chariots. Recent researches have shown that the horse was known to the Harappans in the late period at Harappa.[1] Mackay has illustrated a terracotta model from Mohenjo-daro which he has identified as a horse.[2] Its tail and ears are missing. Lothal has yielded three terracotta models of horse, one of which (pl. CCVIB) resembles Mackay's example. It has a long neck body and prick ears. The tail is damaged and the position of the legs suggests that the animal is running. Its mane is indicated by a slightly-raised band over the neck. A better specimen of the horse (pl. CCVID) from Lothal comes from phase III. It has a short stumpy tail, long body and raised neck. In profile, it looks exactly like a horse. The third example consists of a disjointed head of a horse which must have been attached to the body. A transverse perforation behind the neck suggests that the head had to be manipulated with the string. The prick-ears and snout are characteristic of the horse. This specimen is burnished and thus better treated than others. Horse bones are found at Lothal (p. 641) and Surkotada[3].

A terracotta figure of horse found at Rangpur has a mane indicated by an indented line over the neck[4] The examination of the animal bones from Rangpur has revealed that a domesticated variety of the ass was also known to the Harappans. It may be added that a wild variety of horse namely the *onigar* still exists in Kutch. If the horse was used by the Harappans, as it appears certain from the find of the horse bone (below p. 641) it is not unlikely that the use of the chariot too was known to them. A stone-wheel from Lothal is found to have been carved with zigzag lines[5] etc., along the rim exactly as in the case of

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[1] Wheeler, *The Indus Civilization: Supplementary to the Cambridge Hist of India (Cambridge* 1968) 3rd edition p. 82.

[2] Mackay *op. cit.* 1938 I, 289, pl. LXXVIII, *11*.

[3] Ja P. Joshi, in Radiocarbon and Indian Archaeology (Ed. D. P. Agrawal and A. Ghosh) p. 177.

[4] S.R. Rao, *op. cit.* 1963a fig. 50.

[5] *Indian Archaeology* 1959-60, *A Review* pl. XV B.

the chariot wheels. In this connection the occurrence of terracotta wheels with a prominent hub and painted with intersecting lines indicating spokes (pl. CCXXII B) is highly significant.

F. Pig

Pigs must have been abundant in the marshes of the Indus and Sabarmati rivers. Two terracotta models of pig are found at Lothal (fl. CCIII A). One of them has a thick snout, a large head and a short tail. The nostrils are marked by incisions and the mouth by a slit. The animal is fairly stout. It is not known whether it was domesticated or hunted. Boar-hunting was however common in the Epic period. From the jaw bones of the animal found at Mohenjo-daro Mackay[1] concludes that only the head was brought as a trophy in a pig-hunt. The archaic seals from Susa show that pig-hunt was an important sport.

G. Ram

Two terracotta figures of the ram are found at Lothal. One of them is a hollow head of a ram which must have been fixed to the body (pl. CCV D). The back-sweeping horns are typical of the animal. Another miniature model of a crouchant ram with double-folded legs and back-sweeping horns has also been recovered. The only other specimen of a ram with a hollow head and curved horns from Harappa is of faience. Its face is indicated by a series of nail marks.[2]

H. Elephant

The elephant is frequently represented on the seals from Harappa, Mohenjo-daro and Chanhu-daro as also the sealings from Lothal. A terracotta head of an elephant with a long trunk (pl. CCIII *c*) is an interesting find from Lothal. Although damaged, the essential part which helps to identify the animal, namely the trunk, is clear enough. The sockets of the eyes are marked by incisions and the retina by a pellet. A short tusk in applique technique is seen on one side of the trunk, while on the other it has fallen off. The mouth is indicated by the nail-punch mark. The lower half of the trunk is damaged. The Lothal specimen is better finished than the one from Chanu-daro,[3] the best one being a model from Mohenjo-daro.[4]

The occurrence of the leg-bones of an elephant near the dock at Lothal (below p. 641) establishes that elephants lived in Kathiawar in Harappan times. There is a reference to the elephants from Saurashtra in the *Arthaśāstra* of Kautilya,[5] who says that the elephants from *Saurashtra* and *Pancajana* countries are of poor quality when compared with those from Kalinga, Anga, Karusha and the East. But from the details of the animal shown on the terracotta sealings from Lothal (pl. CLXI, F.) and from the ivory tusk recovered in the excavation, it appears that a good breed of large size existed around Lothal. In fact this animal is better depicted on the Lothal sealings than on the seals from the Indus Valley. Perhaps, the quality of the breed had deteriorated owing to environmental changes in Saurashtra by the time the *Arthaśāstra* came to be written.

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[1] Mackay, *op. cit.* 1938 p. 290.

[2] Vats, *op. cit.* 1940, I, 305.

[3] Mackay *op. cit.* 1943; pl. LVI, *9.*

[4] Mackay *op. cit.* 1938, II, pl. LXXIX, *13.*

[5] *Arthaśāstra* p. 50.

I. Tiger

The tiger was known to the Harappans very well as can be made out from the engravings on the seals from the Indus Valley. Lothal has yielded a terracotta figure of a tiger produced from a double mould, (pl. CCII D). It has a large head, slit-mouth and incised nostrils. The applique eyes in the sunken eye-socket have fallen off. The chequered pattern incised on the body of the beast suggest the stripes on the animal. A large steatite seal from Lothal is also engraved with a striped animal which can be identifed as tiger. The open claws suggest that the beast is about to strike; but owing to damage the head is missing.

J. Rhinoceros

The rhinoceros is also represented on the seals and amulets from Harappa and Mohenjo-daro but not on any from Lothal. On the other hand, beautiful terracotta models have been found here. One of them is a head of rhinoceros. The artist must have made an extremely careful study of the animal before showing all the details such as the thick folds of the hide around the neck, the short horn on the snout, the beady eyes and nostrils. The ears are damaged and one of the pellet-eyes has fallen off. The thick eye-brow is indicated by a curved incised line and the tongue with a pellet inserted in the mouth. How this head was fixed to the body is not clear. A complete but smaller model of the rhinoceros (pl. CCIII D) has also been found. It has a sturdy body, thick short legs and short prick-ears. The mouth is indicated by a nail-punch. The models represent the *rhinoceros unicornis,* which has its habitat in Nepal and Assam even tody. It must have lived in the swamps and marshes around Lothal in the protohistoric period. This animal is engraved on the seals from the Indus Valley. The food-trough depicted in front of the rhinoceros is said to suggest that the animal was kept in captivity. Ramachandran holds the view that the *varāha* mentioned in Vedic and Epic literature was none other than the rhinoceros and not the ordinary pig.[1] Considering the attributes of *varāha* as one capable of lifting the earth it should be admitted that the reference could not be to a weaker species like the ordinary pig, but to a stronger one such as the rhinoceros. The only representation of the animal outside India is on a pre-dynastic vase from Egypt.

K. Leopard

A terracotta animal figure with a long neck and thick head found at Lothal may represent a leopard (pl. CCIII B). Another animal with large circular depressions all over the body may suggest a spotted leopard but other features are more akin to those of a dog.

L. Bear

Lothal has yielded a fine terracotta bust of a bear (pl. CCIV A). The transverse hole through the arms suggests that the bust could be attached to rest of the body and manipulated with a string as in the case of a horse. It has a long snout, prominent nostrils indicated by deep incisions, a slit-mouth and incised eyes. The purpose of perfora-

[1] T.N. Ramachandran, 'Presidential Address to Section I of the *Indian History Congress.*' *Proceedings* of the *Sixth Session* (Agra 1956), pp. 53-69.

ting near the arms may be for suspending the figure so as to move it to and fro as if it was dancing. Even today bears are trained to dance for the amusement of children. It is rather strange that the animal has not been represented in any form in the Indus Valley, but it was well-known at Lothal where several models of it have been found. One of them has a a human body and the head of a bear.

M. Birds

Among the few terracotta models of birds from Lothal, the duck, swan and peacock can be identified (pl. CCVIII A) but details such as the legs and eyes are wanting. The beak and wings are visible in one case. The dove from Mohenjo-daro has its wings unfurled.[1]

A clay model of what looks like a peacock (pl. CCVIII A, *4*) has a long raised neck and a short beak. The plumes are shown by pinched clay at the rear end, but legs and other details are lacking.

A terracotta figure (7739) which must have been wheeled as indicated by the transverse perforations in the rear seems to represent a duck (pl. CCVIII A, *3*). It has a long raised neck and a short beak. An ivory model of a duck is reported from Harappa.[2]

Other figurines of birds cannot be identified for want of details.

N. Miscellaneous Animal Figures

A large number of toy animal figurines with moveable head have been found in the present excavations. They can be grouped under three categories namely, wheeled figures, also called 'brid-and animal-chariots' by Vats and Marshall, animal figures with heads moving in a horizontal or vertical plane, and zoomorphic figures with moveable limbs. The first group consists of four-wheeled animals with provision for attaching wheels, two on either side with the help of sticks passing through the transverse holes in the jointed legs (pl. CCIX A). Very few figures have separated legs with perforation. The transverse hole noticed in the neck of one of the wheeled animal figures was meant for passing a cord.

Some figures have a pronged neck to which a head was attached by means of a stick passing through the holes (pl. CCVII B, *9*). Two such examples are found at Lothal (Nos. 9960 and 2342). A unique specimen (no. 6027) is an animal-head perforated right across both vertically and horizontally so that it could be attached to the body and also moved in different planes. In the case of a humped bull the head could be moved by means of a string passing through holes in the hump and the base of the tail.

The last group of animals consists of zoomorphic figures with a human body and an animal head (pl. CCIV B). In this case the figure is suspended in order to move the entire body on an axle passing through the perforated shoulders. Two examples are a horse-head (no. 14782) and a bust of a bear (pl. CCIV A).

The terracotta horns and heads of animal-figures found in large numbers in a damaged condition at Lothal must have belonged to complete models of animals. Two such heads (nos. 6027 and 2342), with large holes underneath, were apparently meant for being attached to the bodies. Two others (nos. 2398 and 5794) are complete in themselves and cannot be considered as being attached to separate bodies. Similar heads

[1] Marshall *op. cit.* III, (1931) III, pl. XCVI,

[1] Vats, *op. cit.* II (1940) pl. LXXVIII, *19*.

in alabaster, shell and faience found in the Indus Valley[1] and at Tepe Gawra[2] were, according to Mackay, taken out in processions on sticks. The terracotta animal heads from Lothal, however, do not seem to have been used in the above manner. So far as the technique of moulding goes it appears to have been made on a core that eve figure was as is ivident from the smooth intemir of the model. The material of which core was made must have been burnt out completely while baking the model. Vent-holes meant for the escape of the gases formed in burning the material of the core are not noticeable in the case of the hollow head of the ram but they are seen in some of the hollow figures from Mohenjo-daro.[3] The large hollow terracotta horn (pl. CCVIII B) from Lothal must have also been moulded in the same manner in which the hollow head of the ram was made.

No painted animal figures or horns in terracotta were found at Lothal, but a painted horn and a bull were noticed at Rangpur. Vats mentions a painted horn from Cemetery 'H'[4]

Humped Bulls

Pl. CXCVIII C

1. Bull; chocolate slip on buff surface partly faded; moderately baked. Sturdy build with a short thick neck, pellet eyes, prominent slit-mouth, pinched dewlap; thick horns and separated long legs. Damaged; Example of large animal model. From phase II, Period A. (No. 5670).

2. Bull; faded red slip on buff surface; ill-fired. Short thick neck, prominent hump, long erect horns, short tail and jointed stumpy legs. Crude model; from phase IV, Period B. (No. 13747).[5]

3. Bull; faded red slip; ill-fired. Elongated neck; small head; slender but damaged legs; thick short tail and small horns; crude model; damaged. From phase IV, Period A. (No. 31)[6].

4. Bull; faded buff slip; moderately baked; short thick neck; drooping head, short tail and separated legs; crude model; from phase IV, Period A (No. 11750)[7].

5. Bull; slipless; moderately baked. Short thick neck; long muzzle, pinched ears, side stretching horns; tiny hump and separated legs; ear and horn damaged; Crude model. From phase III, Period A (No. 6345).

6. Bull; grey; ill-fired. Thick neck, raised head and hump; short muzzle; wide slit-mouth; ridged dewlap and deep pierced eyes; tail damaged. Rough model. From phase III, Period A (No. 14045).[8]

7. Bull; red slip faded; ill-baked; short raised head; long thick neck, low hump; short snout and separated legs. Crude model. Legs damaged. From phase III, Period A (No. 5946).

8. Bull; grey; well-baked. Short thick neck and snout; prominent hump and dewlap; separated legs and pinched horns looking almost like ears. A small model but not realistic. From phase IV, Period B (No. 11678).

Pl. CXCIX A

9. Bull; dull red; moderately baked. Short thick neck, drooping head, exaggerated hump, thick muzzle, slit mouth, short horns stretched sideways and thick separated legs. Horns and legs damaged. Care-

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[1] Mackay *op. cit.* II 1938 II, pl. LXXIV, 8, 11 and 12, LXXVIII, 6; LXXIX, 23, 23, 32, 33; Vats, *op. cit.* II pl. LXXIX, *67-73.*

[2] Speiser: *Excavation at Tepe Gawra* I, Philadelphia, 1935, pl. LXXVII, 8 and 9.

[3] Marshall *op. cit* I, 1931, I, 349.

[4] Vats, *op. cit.* II, 1940, pl. LXXIX, 73.

[5] Cf. Mackay *op. cit.* II, 1938, pl. LXXVIII, *1;* Vats. *op. cit.* 1940, II, pp. 61-63; pl. LXXIX.

[6] Cf. Tobler *op. cit.* II, 1950, II, II, pl. LXXXII, *1.*

[7] Cf. Bull figures from Rangpur III in *Ancient India* nos. 18 and 19.

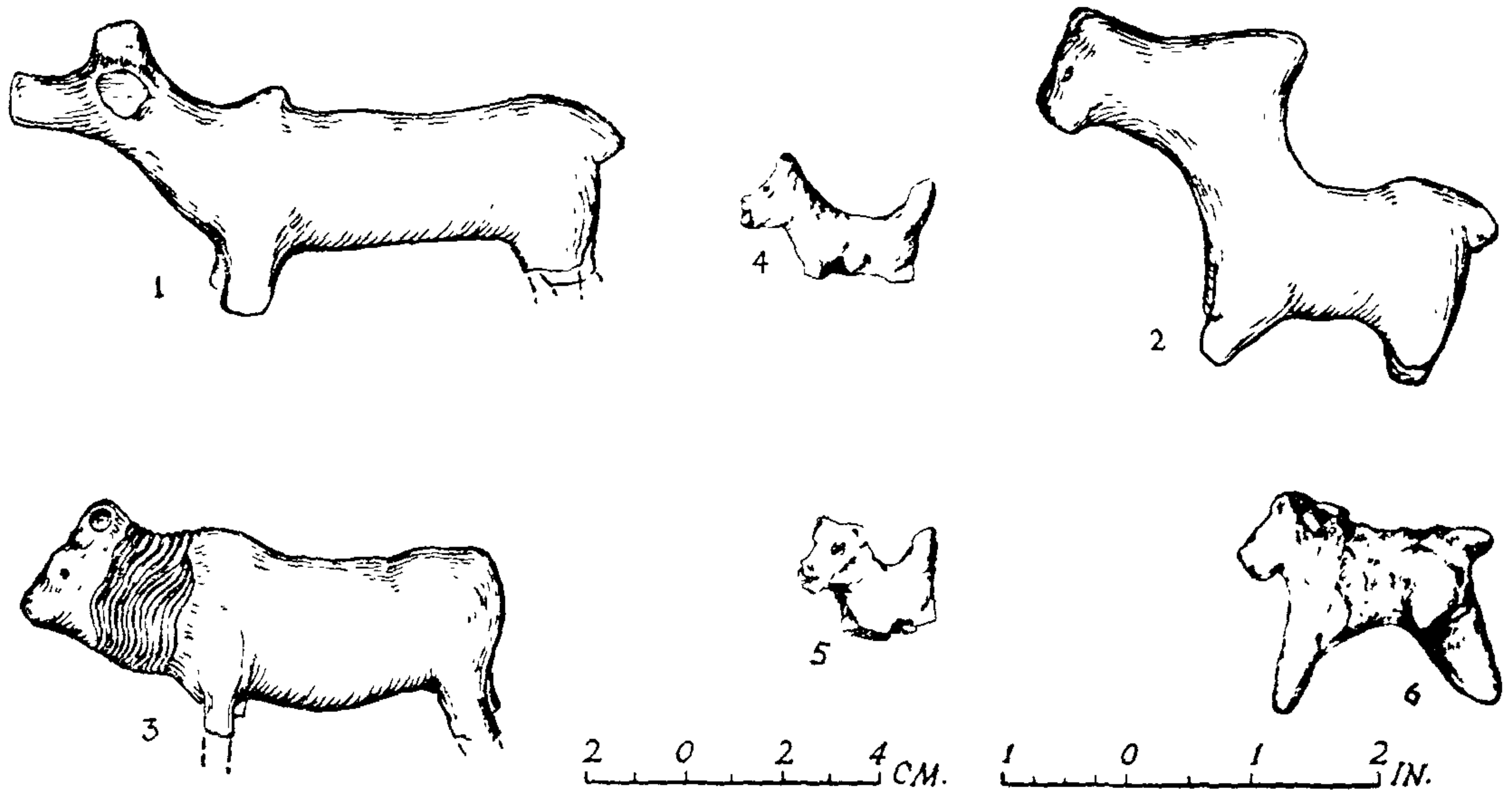

FIG. 99. *Terracotta bulls 1-2 ; humped, 3, humpless; 4-6 dogs*

fully modelled but not well finished. Resembles the present day Sindhi breeding bulls. From phase III, Period A (No. 6336).

Pl. CXCIX B

10. Bull; dull red to grey; sturdy build; short thick neck; short muzzle; exaggerated hump and horns projecting sideways. Legs damaged. From phase II, Period A (No. 6089).

Pl. CXCIX C

1. Bull; grey; ill-fired; sturdy build, short thick neck; low hump; prominent pinched dewlap; wide slit mouth; perforated nostrils; large pellet eyes fallen off from incised eye sockets; large pinched ears; short horns; separated legs and short stumpy tail. Rough model; From phase II, Period A (No. 8745).

2. Bull; cream-washed; moderately baked. Short thick neck and pointed muzzle; short horns stretch ed sideways; thick body; puny hump; tail indicated by ridge and short legs; From phase III, Period A (No. 12335).

3. Bull; faded dull red slip; moderately baked. Long thick neck, dewlap of moderate size; long muzzle; slit mouth, incised nostrils; short thick horns stretching sideways; short thick tail and short legs. Elongated slim body. Male organ indicated by pinched clay. Roughly modelled. Damaged. From phase III, Period A (No. 810).[1]

4. Bull; cream-washed; moderately baked; pronged neck and hump perforated so as to attached a head which could be manipulated by means of a cord tied to the head and passing through the hump. Smooth elongated body. Damaged. From phase III, Period A (No. 9960)[2].

5. Bull; dull-red to grey in colour; ill-baked; sturdy build; drooping head, applique eyes, stretched short horns and rounded snout; small hump. Perforation in the jointed legs for fixing wheels, and an axial hole in the neck for the cord to move the animal. Damaged. From phase IV, Period (No. 9615).[3]

6. Bull; faded red slip; moderately baked; sturdy build; small hump and jointed legs with transverse perforations for fixing wheels. Head missing. From phase V, Period B (no. 3205).

7. Bull; red-slipped; moderately baked: sturdy build; slightly-raised neck, slit-mouth, pierced nostrils, applique eyes, prominent dewlap and pinched but damaged ears; short erect tail: prominent hump and short-jointed legs. Roughly modelled. Damaged. From phase III, Period A. (No. 6209).

Pl. CC A

Bull; dull red; well-baked; elongated body, long thick neck, raised head, long muzzle, thick horns and ears damaged, low hump, short thick legs and short tail carefully modelled. damaged. Phase IV Period A. Surface find (No. 15341) Fig. 99, *1*..[4]

Pl. CC B

Bull; dull red; well-baked; long thick neck; raised head. Pellet-eyes fallen; short horns, highly exagerated hump; short legs; thick tail; crudely modelled; damaged. Period I. Surface find (No. 15342). Fig. 99, *2*. Similar figures occurring in Rangpur II and III resemble the Kankrej breed of present day bulls.

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[1] Vats, *op. cit.* 1940 II, pl. LXXIX, 59.

[2] Marshall *op. cit.* 1931 III, pl. CLIII, 39; Vats. *op. cit* 1940, II, pl. CXX, *16*. and Mackay (1938) pl. LIX *1*.

[3] Mackay *op. cit.* 1945, pl. LVIII, *7*.

[4] *Ibid* pl. LVIII, 8; Marshall *op. cit,* 1931, III, pl. CXVII, *22*.

Humpless Bulls Pl. CC C

1. Bull; dull red to grey; well-baked; short thick neck; drooping head; prominent muzzle and short separated legs with transverse perforations for fixing wheels. Carefully modelled; broken. From phase II, Period A (No. 3711).

2. Bull; dull-red to grey; ill-fired: sturdy build: prominent dorsal ridge indicating vertebral column; short stout legs with blind holes for fixing over a pedestel and thick short tail. Pinched clay band around neck suggesting garland. Might have been an object of worship. Carefully modelled. Damaged. From phase II, Period A (No. 2549).[1] This variety of humpless bull with a prominent backbone still exists in Sind.

3. Bull; faded buff slip over red surface; moderately baked. Pointed muzzle; pinched ears; short horns stretching sideways; thick short neck and inconspicuous dewlap. Damaged. Phase IV. Period A. (No. 13985).

4. Bull; dull red; ill-fired. Pointed muzzle short erect horns; separated long legs; inconspicuous dewlap and ears. Roughly modelled. Damaged. From phase II, Period A (No. 10371).

5. Bull; dull grey; moderately baked. Slim body; short pointed muzzle; drooping head; erect horns; separated legs and thick tail with a stumpy base. Crudely modelled. Damaged. From phase III, Period A (No 2688).

6. Bull; buff; well-baked; Long ears and long narrow muzzle and neck; short horns projecting forward. Highly realistic. Damaged. From phase II, Period A (No. 12335). Resembles the short horned humpless Sindhi breed.

7. Miniature bull; dull red; moderately baked. short muzzle; forward-stretching horns and short separated legs. Crudely modelled. Slightly damaged. From phase IV, Period A. (No. 13682).

8. Bull; dull red; ill-baked; slim body; long muzzle; short erect horns and joined forelegs. Roughly modelled. Damaged. From phase III, Period A (No. 4075).

9. Miniature bull; dull-red to grey; ill-fired; Round body, thick muzzle; pinched horns looking like ears; short stumpy tail and separated legs. Crude model. From phase IV, Period A. (No. 11636).

Pl. CCI A

Bull; buffish; well-baked; stout body; thick neck and head; folds of the skin around the neck indicated by incised wavy lines and the dewlap by pinched clay. Perforated transversely through the head perhaps for fixing horns. Four rows of nail punch-marks on the forehead to suggest ornamental cloth covering; prominent snout; carefully modelled legs; highly realistic. damaged. A very fine specimen resembling the bull-figures from Mohenjo-daro.[2] From Phase III Period A late levels. (No. 17436) fig. 99, *3*.

Pl. CCI B

Cow; cream-washed; moderately baked. slim body with short raised neck; narrow round snout; pinched ears projecting curved horns; long slim legs and short tail; Udders and genital organs clearly indicated. Carefully modelled. Damaged. From phase V, Period B (No. 11037). (Fig. 101 *i*). Another specimen also found at Lothal from surface.

Spotted dogs

Dog; chocolate over dull red surface; moderately baked. Long neck; thick prick ears; short raised tail and sturdy legs. Deep circular depressions suggest spots over the body (pl. CCII A). Damaged. From phase IV, Period A (No. 11336).

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[1] Marshall *op. cit* III, 1931, III, pl. XCVIII, *23*.

[2] Mackay *op. cit.* II, 1938, pl. LXXIX, *24*, and *30*.

Other figures of dog

1. Dog; buff-slipped; moderately baked. Prominent head; thick neck, slit mouth, incised nostrils, thick pinched ears; thick tail and sturdy short legs; pellet eyes fallen off. Crudely modelled. Damaged; Unstratified. (No. 6282).

2. Dog; dull red to grey; ill-baked; sturdy build high stature; short neck and snout; slit mouth, prick ears short raised tail and separated legs. Crudely modelled. From phase II, Period A (No. 9037).

3. Dog; buff; moderately baked. Short raised neck; short pointed snout; raised thick tail and separated legs. Crudely modelled. Damaged. Unstratified. Period A (No. 6039).

4. Dog; dull red; moderately baked. sturdy build; thick neck; short narrow snout; pinched ears, raised tail and separated legs. Roughly modelled. Damaged. From phase II, Period A. (No. 5389).[1]

5. Dog; dull red to grey; ill-baked. short neck long narrow snout, prick ears; drooping tail and long separated legs. Crudely modelled. Damaged. Unstratified. Period A (No. 6038).

6. Dog; faded chocolate slip; well baked; short thick raised neck; short snout; slit mouth; prick ears; short raised tail and short sturdy separated legs. Roughly modelled. Damaged. From phase II, Period A (No. 997).

8. Dog; grey; moderately baked. short neck and snout; raised head; incised nostrils; pinched ears and jointed forelegs. Transverse perforation meant for moving the object as a toy. Crudely modelled. Damaged. From phase III, Period A (No. 14691).

9. Dog; faded; red slip; well-baked. Thick long neck; narrow long snout; slit mouth, applique eyes; fallen off; short sturdy leg. Crudely modelled. Damaged. From phase IV, Period A. (No. 3894). Fig. 99 *4*.

10. Dog; dull red; moderately baked; thick raised head; short snout; prick ears; incised mouth; erect tail; short and separated legs. Applique collar faintly visible; Carefully modelled; suggests a running dog. Damaged. From phase V, Period B. (No. 11910).

11. Dog; dull red to grey; well-baked; long stretched neck; short ugly snout; prick ears and short legs. Crudely modelled. Damaged. From phase V, Period B (No. 6558).

Pl. CCII B

12. Dog; buff; moderately baked; thick raised neck; long snout; slit-mouth- incised nostrils and eyes; prick-ears and long erect tail. Represents a street-dog. Damaged. From phase III, Period A (No. 11887). fig. 99, *5*.

Pl. CCII C

14. Dog; dull red; moderately baked; sturdy build; thick neck; short round snout; pinched ears; long legs and raised tail. Hair indicated by pinched clay over the neck. Perhaps a mastid. From phase II, Period A. (No. 5042), Fig. 99, *6*.

Other animals

Pl. CCII D

Tiger; faded red slip; moderately baked; moulded in two parts. Body incised in chequered design; thick raised head; heavy jaws; slit mouth; large incised eye; nostril indicated by oblique cut and stumpy leg. One half of the animal taken from a double mould; damaged. From phase III, Period A (No. 2014). Terracotta figures of tiger are recorded from Mohenjo-daro[2] and Harappa also.[3]

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[1] Cf. Tobler *op. cit* II, 1950, pl. LXXXII, *4*.
[2] Marshall, *op. cit.* 1931, III, pl. LXXIX, *13*.
[3] Vats *op. cit,* 1940 II pl. LXXIX, 80-82

Pl. CCIII A

1. Pig; ill-fired; stout body; two prominent projections suggesting horns or ears; short snout and tail and separated legs. Crudely modelled. From phase IV, Period A (No. 7625). A similar figure identified as pig occurs in Ur. Models of pig found in Mohenjo-daro[1] and Harappa[2] are cruder than the Lothal specimen.

2. Pig; faded red slip; ill-baked; stout body, thick head and snout; slit mouth; incised nostrils and stout short legs. Crudely modelled; damaged; Phase III; Period A (No. 5735). Resembles the Mohenjo-daro specimen.

Pl. CCIII B

Leopard; red to grey in colour and ill-baked; round head and snout; stretched neck to the level of the body; bulging eyes slightly visible and stout short legs. Crudely modelled; Damaged. From phase III, Period A. (No. 8476). Leopard not known in the Indus Valley art.

Pl. CCIII C

Elephant; faded buff slip; ill-baked; Round head; long trunk; slit mouth; applique tusk near the mouth; incised eye-brow and thick neck. Damaged. From phase III, Period A (No. 3943).

Pl. CCIII D

Rhinoceros; dull red; well-baked. Sturdy body, a short horn on the thick snout; slit mouth; prick-ears stout short separated legs and faintly visible tail. Carefully modelled and highly realistic but wanting in detail when compared with the rhinoceros head from the same site. Unstratified. Period A (No. 6037).

Bear; deep-red slip; burnished and well-baked; Long snout; slit mouth; incised nostrils and eyes; short thick neck; perforated through shoulders for a stick or cord to pass so as to move the animal for amusement. Damaged. Reconstructed. From phase III, Period A (No. 2999).

Pl. CCIV B

Composite figure; faded red slip; well-baked and burnished. Squatting figure with a horse-head; long neck and snout; slit mouth and prick-ears.

Transverse perforation along the shoulders meant for fixing a stick. Probably a human figure with a horse head meant to be set upright as suggested by a hole beneath. From phase IV, Period A (No. 14972). Similar figures with a moveable human or animal head found in Mohenjo-daro.

Pl. CCV A

Head of rhinoceros; red-slipped and well baked; Flat base; thick neck; folds of skin indicated by thick corrugations, jaws demarcated by incision. Characteristic snout with a single horn at the tip; deep pierced eyes and stretched tongue indicated by clay pellet; model realistic and well proportioned. From phase III, Period A (No. 5274).[3]

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[1] Mackay, *op. cit* 1938, II, pl. LXXVII, 20.

[2] *Ibid*, pl. LXXIX, *1*.

[3] Marshall, *op. cit.* 1931, III, pl. CLIII, 38, I. p. 549 Mackay, *op. cit.* 1938 II, pls. LXXVIII, 12. LXXXI, 8 and 14.

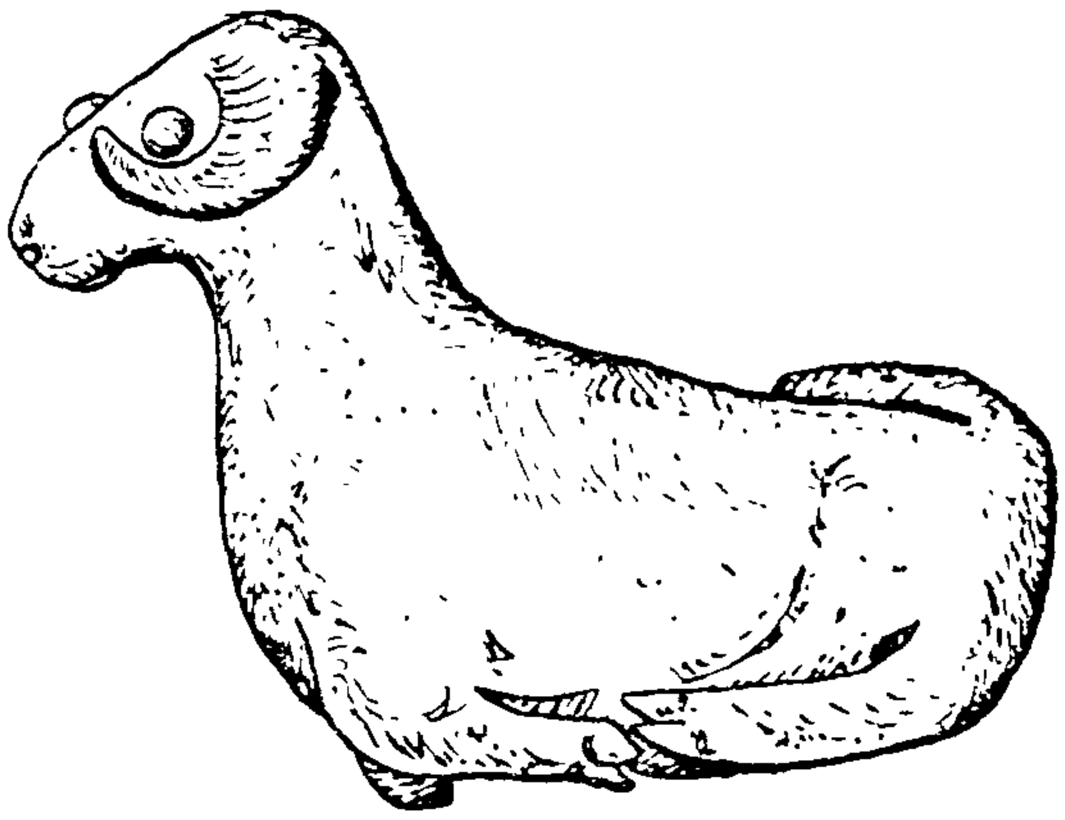

FIG. 100. *Terracotta Ram. Scale ½*

Pl. CCV B-C

Ram; dull red; well-baked; thick raised neck; narrow snout; curved horns; folded legs indicating the crouchant position of the animal; Realistic; Damaged; Unstratified, Period A Fig. 100.

Pl. CCV D

Ram; faded red slip; well-baked. Hollow head; thick tapering snout and thick curled horns; realistic representation. A unique example of hollow model. From phase IV, Period A (No. 9425).[1]

Pl. CCVI A

Squirrel; dull red; ill-baked. stout neck, rectangular head; prick ears; mouth indicated by a circular depression. The animal shown in sitting posture with its forelegs stretched forward. Damaged. From phase V, Period B (No. 10271). More realistic figurines of squirrel occur in Harappa[2] and Mohenjo-daro[3].

Pl. CCVI B

Horse; dull red to grey; ill-baked; long body long neck, prick ears; short thick snout; mane indicated by a low ridge over the neck and thick stumpy tail. Crudely modelled. Damaged. From phase III, Period A (No. 2203) Fig. 101, *3.*

Pl. CCVI C

Unicorn; buff; well-baked. Only head intact. Single horn projecting from forehead, pinched ears and stout snout. Pellet eyes fallen off. Nail punch marks on the neck. Damaged. From Period A. Aunique specimen. Fig. 100, *4.*

Pl. CCVI D

Horse; dull red; moderately baked; Long slim body; long raised neck, short pointed snout; prick-cars mane indicated by a low ridge over the neck; short stumpy tail and short separated legs. Highly realistic. Ear damaged. From phase III, Period A (No. 2703), Fig. 101, *2.*

Detachable animal heads

Pl. CCVII A

1-2. Animal head; grey to dull red; moderately baked; Thick muzzle and short thick horns stretching sideways. Flat triangular neck with a vertical hole for fixing the head over the body. Eyes perforated for the passing a thread. Marks of use seen around the neck. Damaged. From phase IV, Period A (No. 6027).

3. Head of a bull; red; moderately baked. Fan shaped head with perforations on the prominent round muzzle and at the neck for passing strings. Horns stretched sideways. A unique detachable head used as toy. From phase III, Period A (No. 2342).

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[1] Marshall *op. cit.* 1931 III, pl. XCVI, **24**; Mackay *op. cit* 1938 II, pl. LXXIV, **6**; LXXVII, *15.*

[2] Vats, *op. cit.* 1940, II, LXXVIII, *44-54.*

[3] Marshall, (1931) III, XCVI, 21-22.

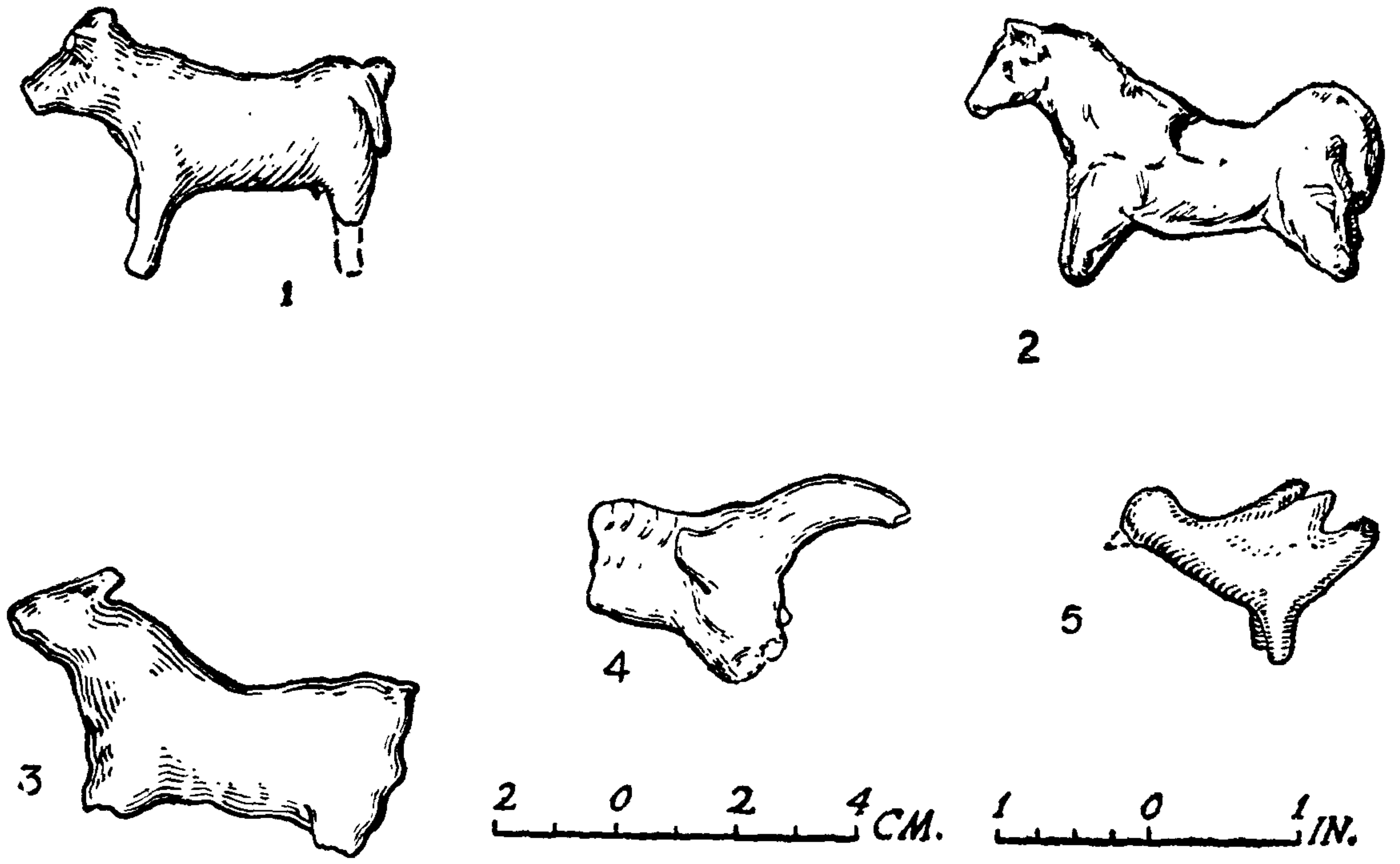

FIG. 101. *Terracotta cow (1), horses (2-3), unicorn (4), flying bird (5)*

Pl. CCVII B

1. Animal head; grey to dull red; ill-baked; prominent muzzle; out-stretched curved horns; perhaps head of a ram. Roughly modelled. Damaged. From phase V, Period B (No. 12900).

2. Animal head, grey to dull red, ill-baked; Prominent muzzle, slit-mouth, nostrils indicated by vertical notches and curved horns. Roughly modelled. From phase III, Period A (No. 13508).

3. Animal head, faint buff slip; ill-baked. Thick bulged muzzle, deep slit-mouth, incised nostrils and and short thick horns. Unfinished. Roughly modelled. From phase II, Period A (No. 5794).

4. Animal head; buff slip; ill-baked; Prominent round muzzle, wide open mouth, long neck with axial perforation for attaching to the body. Roughly modelled. Damaged. From phase III, Period A (No. 12009).

5. Animal head; buff slip; well-baked. Large head with erect horns; broad muzzle and protruding pinched eyes. Well-modelled. Damaged. Perhaps the head of a bull. From phase IV, Period A (No. 13090).

6. Animal head; grey to dull red; ill-baked; Short thick muzzle, slit-mouth, short side-stretching horns; folds of dewlap indicated by pinched clay. Damaged. From phase V, Period B (No. 8371).

7. Animal head; grey to dull red; moderately baked. Broad triangular muzzle and short horns projecting forward. Unfinished. Damaged. From phase III, Period A (No. 2398).

8. Animal head; grey; moderately baked. Thick round muzzle; incised eye-sockets and long erect horns. Roughly modelled. Damaged. From phase V, Period B (No. 11095).

9. Unidentified; grey to dull red; well-baked; Long pronged neck and beaked muzzle. The transverse hole for attaching to the body with a string. Well-modelled. From phase IV, Period A (No. 4494). May be a toy animal with moveable parts.

Birds

Pl. CCVIII A

1. Unidentified; red slip over buff surface; moderately baked. Thick raised neck, short beak, perforated below the neck for suspension. Sitting posture of bird. From phase IV, Period A. (No. 1468).

2. Unidentified; buffish; ill-baked. Sharp beak at one end and perhaps feathers indicated at the other end. May represent fowl. From phase III, Period A. (No. 13729).

3. Duck; dull red; moderately baked. Round body pointed beak, short thick neck and feathers indicated by pinching clay. Sitting posture. Unstratified. Period A (No. 2374).

4. Peacock; ill-baked. Long graceful neck, small head, thick round body and folded feathers. From phase III, Period A (No. 2555).

5. Swan (?) dull red; moderately baked. Long neck, sharp mouth; transverse hole meant for attaching to a toy cart or some other object. From phase IV, Period A. (No. 7739).

Animal head, horns etc.

Pl. CCVIII B

1. Animal head; dull red; moderately baked. Prominent round muzzle, slit mouth, eye indicated by low depression, incurved horns and pinched ears. Well modelled. Damaged. From phase V, Period B (No. 8963).

2. Horn; grey; moderately baked. Solid and incurved. Perhaps belongs to a humped bull as indicated by the knob at the base. From phase V, Period B. (No. 14758).

3. Horn; faded red slip; well-baked. Hollow. From phase II, Period A. (No. 250).

4. Horn; dull red; ill-baked. Curved and pointed. From phase III, Period A. (No. 7765).

5. Horn; short; light red; solid, curved and pointed. From phase II, Period A (No. 10902).

Miscellaneous figures

Pl. CCIX A

Wheeled animal with a thick head and jointed legs. Wheels are restored. Phase III. Period A.

Pl. CCIX B

Wheeled bull with a drooping head perforated axially in the neck for stringing. Wheels restored. Phase IV. Period A.

Pl. CCIX C

Bird (?) with partially spread wings; perhaps the stump below was meant for fixing it in a base. Unstratified. Period A (No. 173888), fig. 101, **5**.

Pl. CCX A

Wheeled bird. Axial perforation in the belly for an axle and vertical hole in the neck for stringing. Wheels restored. phase IV. Period B.

Pl. CCX B

Bird with vertical hole for the stick; terracotta base also found in excavation. Stick restored. Phase III Period I.

4. TOOLS AND INSTRUMENTS

A. Muffles, Crucibles and Moulds

The coppersmiths and goldsmiths used muffles, crucibles and moulds in terracotta for melting and casting metals. The crucibles (pl. CCXIII) are of two types, one being a shallow bowl in which the ingot was melted and the other a channel for pouring molten metal. In the latter case the open end could be closed by placing a lump of wet clay. The crucibles have thick walls rendered coarse by the use of sand in the mixture. Two out of three crucibles illustrated in pl. CCXIII C come from the coppersmith's workshops, one in the bazaar street and the other at the northern end of the town. A compartmented rectangular vessel containing traces of metal must have been used as a muffle. Its thin walls suggest that it was not subject to high temperature. Perhaps molten metal was poured into it to obtain small cubes. Other muffles are shallow and thin bars could be had by puring molten metal into them.

Excepting a rough mould in stone for casting copper pins no mould in terracotta for casting tools and figures has been found at Lothal. Most of the ornaments such as heads and bangles were made by beating the sheet metal, but pins, celts, chisels, drills, spear-heads, daggers and small figurines could not have been cast without moulds. Only four terracotta objects suspected to be moulds and probably meant for pressing metal foils over them have been found here. Three of them are rectangular on plan and their edges are slightly raised by pinching clay thus producing a shallow groove along the rim (pl. CCXIV A). Another object, circular on plan, has a floral design produced by finger-tip depressions in its concave

surface. Perhaps gold foils covering these moulds could be used as ornaments. Similar objects were found at Taxila.

B. Plumb-bobs

Carrot-shaped terracotta objects with or without a tang appear to have been used as plumb-bobs by the masons to check the perpendicularity of the structure under construction. Among them two types may be distinguished (pl. CCXI B). One of them has a vertical hole right through the body for passing a thread (fig. 102, *1*) while the other, conical in shape, has a small grooved knob for tying a cord which passed through a perforated terracotta disc. Even now brass blumb-bobs are used in this way.

C. Cylinder

Several cylindrical objects with a shallow depression in the centre have been found at Lothal. Mackay[1] has considered similar objects having axial holes as bobbins or gaming pieces. In the absence of any perforation in the Lothal specimens they cannot be considered as bobbins. They are too small and light to be used as net-sinkers or as loom weights. On the analogy of the terracotta nails found at Ur, it can be said that these cylindrical and pulley-shaped clay-rolls were used for decorating wells. In some cases the waist is narrow and in others almost non-existent. The latter type might have been used for decorating walls.

D. Loom-weights and Net-sinkers

Thousands of ovoid and tabloid terracotta balls with four finger marks found at Lothal (pl. CCXXX I) are considered net-sinkers. Objects of similar shape in brick or terracotta are still used at Kaveripattinam as net-sinkers (pl. CCX C). One of them in brick was used as a loom weight (pl. CCXVI A).

E. Spindle-whorls

The evidence of the use of woven fabric at Lothal is provided by a cloth impression on a terracotta sealing. All the equipment necessary for spinning and weaving must have been available easily. In addition to the loom-weights mentioned above two types of terracotta spindle whols have also been found. One of them is of arecanut shape with a concave or flat disk-base and a narrow top, while the other is only a ring with a rectangular or plano-convex section. Normally there is only one hole in the centre for spindle (pl. CCXIA). In those whorls which have two marginal holes the spindle is split and fixed in the holes. If there is a third hole a bottom pin is fixed to facilitate quick momentum. The Bharwars who are expert spinners and keep on moving from village to village with their herds of cattle and sheep in Gujarat use both the types of *takli* for spinning wool.

F. Spools

The Harappans used terracotta disks having numerous holes as spools by fixing a number of sticks between two disks. (pl. CCXII A-B) Some of them are thick tabloids whiles others are wheels with prominent hub.

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[1] Mackay, *op. cit,* 1943, pl. LIX, 42.

G. Ladle

An object of domestic use found at Lothal is a terracotta ladle with a tapering handle (pl. CCXVIII A). It seems to have been used for pouring liquid into the fire while performing some rituals. The present specimen was found very close to the rectangular brick-altar in G Block and is suspected to have been used for fire-worship. The soot-marks on the rim and under-surface of the ladle suggest that it came in contact with fire. A similar ladle was found at Ur but none in the Indus Valley.

Crucible and moulds

Pl. CCXIII A

1. Large sturdy crucible with thick gritty walls; soot-marks visible. Damaged. From phase III, Period A. (No. 14856).

Pl. CCXIII B

1. Crucible with a spout for pouring molten metal. From phase III, Period A.

Pl. CCXIII C

1. Crucible with thick low walls; gritty fabric; Creamy patches suggest use of lime. From phase II, Period A. (No. 2644).
2. Small crucible with two rectangular compartments one of which is broken. Traces of metal visible. From phase III, Period A. (No. 1509.)
3. Mould with two rectangular compartments one of which is broken; thin walls. Smoke marks on both sides. From phase IV, Period A (No. 15028).
4. Mould with two compartments; thin walls; traces of metal collected from scrapings. From phase III, Period A (No.5563).
5. Mould with a shallow rectangular compartment for pouring molten metal. Unstratified. Period A. (No. 6002).
6. Mould with two thumb-shaped depressions one of which is damaged. From phase II, Period A (No. 15090).

Pl. CCXIV A

1. Mould; grey; moderately baked. Rectangular with slightly raised walls and low channel-like depression along the margins. From phase III, Period A (No. 3384).
2. Mould; red; moderately baked. Rectangular with slightly raised walls and low channel on three sides. From phase IV, Period A (no. 13855).
3. Mould; grey; well-baked. Square with raised edge and low channel along the margin. Damaged. From phase IV, Period A. (No. 5438).
4. Mould; light red; moderately baked. Circular round base and shallow interior with nine shallow circular depressions. Used probably for pressing metal foil. From phase V, Period B. (11207).

Spindle whorl

Pl. CCXIV B

1. Spindle whorl; red-slipped; moderately baked; Plano-convex section; truncated discoid top; flat circular bottom and a vertical hole for fixing the spindle. From phase V, Period B (No. 9177). Fig. 102, *3*. Occurrs in Tepe Gawra also.

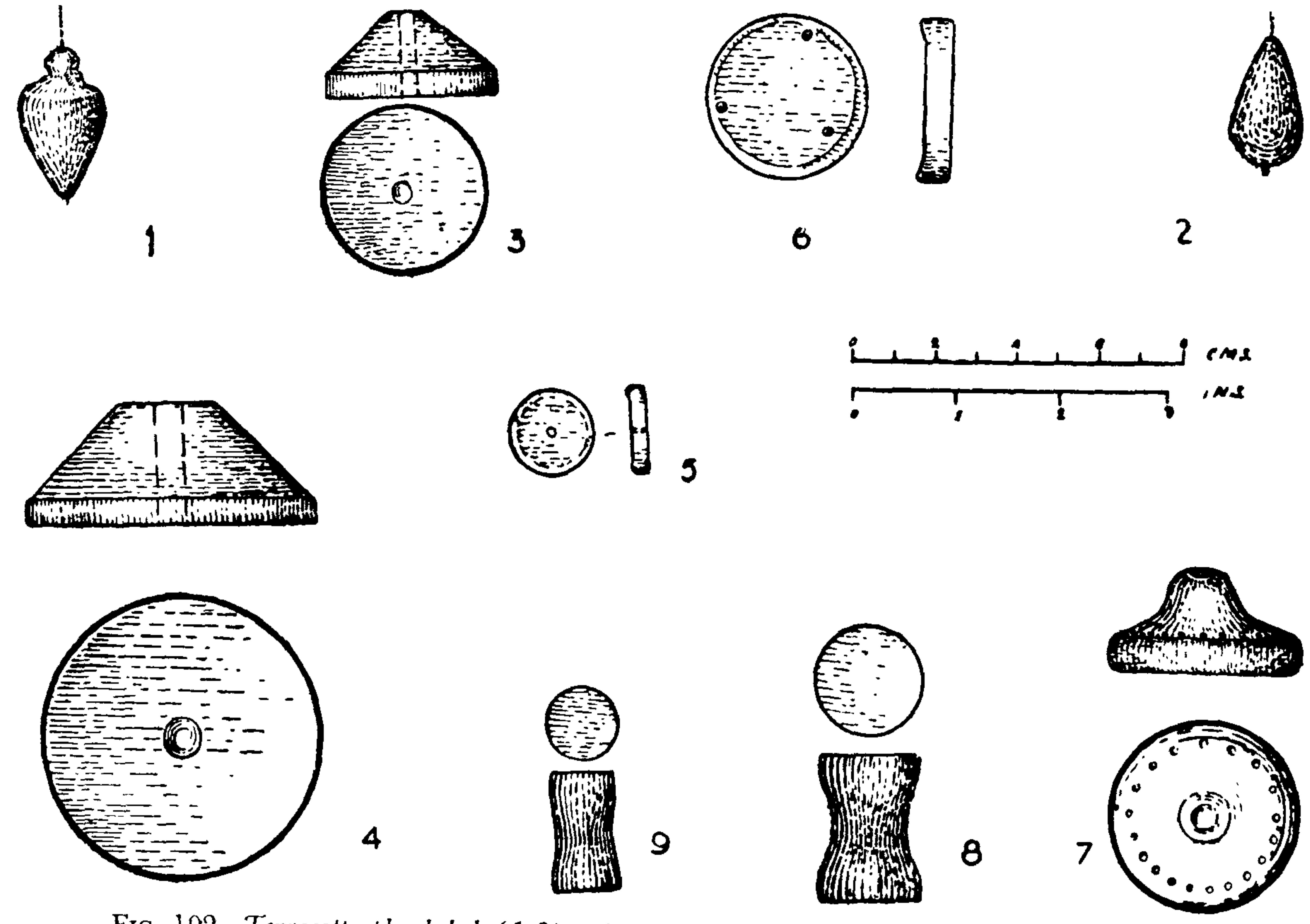

FIG. 102. *Terracotta plumb-bob (1-2), spindle whorl (3-5), spool (6-7), loom weight (8-9).*

2. Spindle whorl; dull red; ill-baked. Plano-convex with flat circular bottom, trutncated discoid top and a circular hole. Irregular edges. Roughly modelled. From phase V, Period B (No. 9220). Fig. 102, *4.*

3. Spindle whorl; buff; well-baked. Rubbed potsherd with a rectangular section and circular on plan with a hole in the centre. From phase IV, Period A (No. 14309).

4. Spindle whorl; grey to dull red; moderately baked. Rubbed potsherd. Other details as above. From phase III, Period A (No. 6987), Fig. 102, *5.*

5. Spindle whorl; dull red; ill-baked. Almost rectangular in section and circular on plan with raised edges and three perforation on the margin for taking a split spindle. From phase V, Period B (No. 14007).

6. Spindle whorl; grey to dull red; ill-baked Other details as above. From phase IV, Period A (No. 14123). fig. 102, *6.* The disks were used as pans for weighing scales but this one is too small to be used as pan.

Plumb bobs

Pl. CCXV A

1. Carrot-shaped cone with a round head for suspension by a string. Unstratified. Period A. (No. 50). Fig. 102, *1.*

2. Carrot-shaped cone with a vertical hole from base to top for passing the thread. From phase III, Period A (No. 1904). Fig. 102, *2*

3. Carrot-shaped cone with round top and a blind hole. From phase I, Period A (No. 1812).

4. Carrot-shaped cone with a slightly raised top and a blind hole. Damaged. From phase IV, Period A. (No. 5584).

Pl. CCXV B

1-2. Cylindrical pulleys with narrow hole in the centre. Perhaps used as whorl.

Loom-weights

Pl. CCXV C

1. Long cylindrical; biconcave; flat top and bottom. From phase V, Period B (No. 1002). fig. 102, *8.*
2. Long cylindrical; slightly biconcave; flat top and bottom. From phase III, Period A (No. 11796).
3. Long cylindrical; biconcave; round top and bottom. From phase II, Period A (No. 1328).
4. Short cylindrical; biconcave; low depressions in top and bottom. From phase III, Period A (No. 2509).
5. Long cylindrical; biconcave; flat top and bottom. Burnished. From phase IV, Period A (No. 13576).
6. Long cylindrical flat top and a depression in the bottom. From phase V, Period B (No. 13832).

These objects appear to have been used for tying together groups of warps in a loom to hold them in position.

Pl. CCXVI A

Loom weight; tapering cubical bricjk used as a weight for holding the loom in position. From phase IV, Period A. Even now such weights are used; fig. 102, *8.*

Spools

1. Spool; dull red; well-baked; Plano-convex in section in section and circular on plan with numerous holes along the margin for fixing sticks. From phase III, Period, A.

2. Spools; dull grey; ill-baked; conical knob on one side and circular on plan with numerous holes along the margin and in the centre. From phase IV, Period A (No. 7876). Fig. 102, *5.*

Pl. CCXVI B

Demonstration of the use of terracotta spolls (from Lothal) in a modern *charka*.

5. HOUSEHOLD OBJECTS

The earthenwares meant for domestic use e.g., jars, *lotas*, beakers, goblets, lamps, feeding cups etc., have been described under pottery (above p. 337 *ff.*).

Pl. CCXVII A

Ladle: dull red to grey; well-baked; deep circular receptacle and a short pointed handle. Soot marks visible on the back. From phase V, Period B. (No. 15056).

6. GAMESMEN AND TOYS

As many as seventy five terracotta gaming pieces, five boards in brick and terracotta, and a dice have been found at Lothal indicating thereby that more than one type of indoor games involving the use of dice, boards and gamesmen were popular. Lothal has also yielded some gamesmen in stone, ivory, bone and shell.

A. Gamesmen

The terracotta gaming pieces from Lothal can be divided into five main types, namely, zoomorphic figures, pellets, tetrahedrons, cones and castles. From the various types of gamesmen available it appears a game similar to the modern chess and the other involving the use of dice were popular with the Harappans. Another type is indicated by the large number of small pellets, some of which have blind holes at the corners.

The zoomorphic figures represent the dog, bull and horse. Gamesmen nos. 137 and 831 (pl. CCXVII B *1* and *2*) with their projecting horns, short snout and slit mouth suggest the bull, while gamesmen nos. 8298, 12589 and 6974 (pl. CCXVII B *5* and *6*) with their lop ears, thick snout etc., represent the dog. The gaming piece no. 1213 with prick ears and long snout may represent the horse (pl. CCXVII B *3*). It is interesting to note that gamesman no. 8298 is similar to the one from Tepe Gawra,[1] both being highly stylised representations of dog.

Small clay lumps or pellets pressed between three fingers and found in large nos. at Lothal and Indus cities might have been used as gamesmen (pl. CCXVIII A *1* to *3*). They bear finger marks and the edges are rounded. Hundreds of them were found at Harappa in a jar and most of them are said to have blind holes at the corners. Vats believes that they were inlaid as in the case of the pellets from the Royal Cemetery at Ur. Out of a large number of pellets from Lothal only one (no. 11938) has blind holes in the corners (pl. CCXVIII A). Terracotta objects with a knobbed head and a square or rectangular base with a slightly concave undersurface are also suited for being used as gamesmen (pl. CCXVIII B) or as simple spinning toys, but not as lids of miniature vessels.

Another type of gamesman common to Lothal and Tepe Gawra[2] is the conical one of which six different sizes perhaps with different values, are available. Some of them have a flat circular base and taper to a point. In a few other cases the top is truncated

[1] Tobler *op. cit.* 1950, II, pl. LXXX, *4B, 2.*

[2] *Ibid,* pl. LXXX, *4c.*

(pl. CCXVIII A, *4* to *12*). Among the tetrahedrons two types can be made out, the larger having a blind hole in the apex for fixing a stud or a figure of ivory or bone and the smaller one without any kind of perforation (pl. CCXVIIIB, 11 to 14). This presumption is substantiated by an ivory stud fixed in a tetrahedron (no. 1105). The tetrahedrons might represent foot-men in a game of chess, while castles, cones, zoomorphic figures and tetrahedron with ivory figure might have represented other powers such as the king, minister, elephant, horse, chariot etc. The close resemblance between the various types of terracotta gamesmen from Lothal and modern chessmen is remarkable. It appears that the Indian game of chess *(chaturanga)* had its origin in one of the Harappan games. For purposes of comparison the gamesmen from Lothal are placed in their relevant positions, opposite the modern chessmen of a chess board in pl. CCXXIA.

A gaming box from the tomb in Memphis belonging to the reign of queen Hatshepsut[1] was found to contain gamesmen of the castle type in blue faience. They are of various sizes as in Lothal and some of them have a thin waist and are surmounted by a convex head while others have a thick waist and a large head. The alabaster gaming piece of a dwarf castle-type from Susa II[2] is comparable with a similar one from Lothal (pl. CCXVIII B). The squattish castle-type without a head and the conical type from Lothal are also similar to those from Memphis.[3] Thus it is evident that gamesmen of castle type were popular in Egypt, Sumer, Indus valley and Kathiawar. The tetrahedrons in steatite from Susa II[4] and the terracotta pellets from Ur[5] closely resemble those from Lothal. The smaller pellets must have been used in a game similar to the modern one involving the use of a wooden board with two or more rows of circular depressions. Similar terracotta tokens, spheroid, cone, disc, tetrahedron and ovoid from uruk were used for keeping account of cattle sheep etc.

B. Dice. (pl. CCXIXA)

A cubical terracotta dice found at Lothal is marked with small blind holes on all sides as follows: one opposite two; three opposite four and five opposite six. The same order is noticed in the case of the dices from Harappa[6] and Mohenjo-daro. In addition to this type two others with different markings are recovered from the Indus Valley. In one case the numbers are one opposite two; three opposite five and four opposite six. In another case the markings are one opposite six; two opposite five and three opposite four thus making the sum of the numbers on opposite sides seven as in the case of modern dice and the Egyptian dice of ancient times (Hatchepsut Period). The starting point is 1 but not 2 in the case of Indian dices.

Gambling was popular in India even in the Rigvedic times. This included dice also. The Vedic dice is said to have been made of *vibhītaka* wood *(Terminalia bellerica)* but the shape is not known. The Harappans used bone, ivory shell and terracotta for making dice, the shapes varying from cubes to cylinders. According to Mackay[7] the idea of using cubical dice came from Ur, but this does not appear so, for, all the types are noticed in the Indus valley. In Ur and Tell-el-Amarna the numbers are marked by painting circlets, whereas at Lothal and the Indus cities the terracotta dices are marked with blind holes and

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1 Petrie *op. cit.* 1920;

2 In the reserve collection of the Louvre Museum, Paris.

3 Petrie *op. cit.* 1920,

4 In the reserve collection of the Louvre Museum, Paris.

5 Wooley *op. cit.* 1934. II, pl. 95.

6 Mackay *op. cit.* 1938, II, pl. CLXII *84-86.*

7 *Ibid* I, p. 437.

those in shell and ivory with incised circles. No pyramidal or cylindrical dices are found in Kathiawar.

C. Game-boards

In addition to a game involving the throw of dice the Harappans played several others in which the movement of the gamesmen was determined by convention necessitating the use of boards. Five game boards marked in three different ways have been found at Lothal (pl. CCXIX B *1* to *3*). One of them is comparable with the board from Susa II. A second type is marked with concentric squares, each side being further divided into two by a line running across the squares (pl. CCXIXB). The third type consists of sixteen houses marked in the form of a rectangle. All these types are still in use in India, the second and third types being traceable up to mediaeval times.

The boards must have been generally made of wood. As regards their shape and size one has to guess from the terracotta models found at Lothal. The Egyptian boards were inlaid with ivory and shell and the gamesmen were also made of the same material. Such Boards have been found at Tepe-Gawra and Ur along with gamesmen. The close resemblance between the shell and ivory inlays from Lothal and those of Egypt, Ur etc., suggests that Kathiawar supplied the requirements of Egypt and Sumer. Trade might have resulted in the adoption of common games in different regions.

D. Toy-carts

Three types of toys-carts are found at Lothal, whereas only two are found in the Indus Valley. The first type had a solid chassis, concave or flat (pl. CCXXI B, *3*). The second type had a perforated chassis in one piece (pl. CCXXI B, *2*) and the third a detachable cross bar in the perforated chassis (pl. CCXXI B, *1*). The longitudinal hole in the third type was meant for receiving a lorgitudinal bar to which the yoke was attached. Three pairs of holes seen in the centre across the frame were meant for attaching the axle and the four more holes, one at each corner, were meant for fixing posts. The holes on the margins of the second type were also used for the same purpose. They along with other wooden bars formed a detachable wooden frame. They are all held in position by interlacing cords as shown in the second type. In some cases the central longitudinal bar passing through the chassis projects at the rear end. In the third type the various parts of the chassis are secured with lashings passing through the vertical holes in the projecting undersurface (pl. CCXXIL A, *6* and *8*) where the axle was attached. Wooden cross-bars were fixed at the terminals in the horizontal perforations, while the pegs were fixed in the vertical holes. A variant of this type of cart-frame consists of two simple curved bars with four horizontal and four vertical holes in each bar for fixing pegs and cross bars (pl. CCXXII A, *7*). The axle was normally attached to the chassis by means of leather straps passing through the holes in the frame and the wheels were attached to the ends of the axle which projected from the body. Perhaps lynchpins held the wheels in position.

The first type of solid frames with or without projections as also the second one with a perforated frame in one piece have been found in the Indus Valley. The third type, namely, a perforated frame with a detachable cross-bar and its variant having chassis made up of two curved pieces are not found elsewhere than in Kathiawar. Apparently, land-transportation was slow, but carts of the first two types were meant for carrying heavy loads while the third type was meant for light loads. The small cart with two curved pieces forming the chassis was the forerunner of the present day *ekka* now mostly found in Northern India, especially in Banaras and Mathura. It resembles to some extent the horse-drawn chariot

described in the Rigveda. The striking feature of this type is the projection at the bottom of each curved bar to which the axle in the form of a cross bar was fixed. The advantage lay in that the floor of the chassis is kept considerably above the nave of the wheel unlike in the other two types. An alabaster wheel from Lothal carved with intricate designs may belong to a toy chariot (below The occurrence of terracotta figurines of horse is another evidence suggesting the use of the chariot by Lothal folk.

Terracotta models of wheels used for toy carts are found in large numbers. Some of them are found to have been moulded have a prominent hub on either side or on the interior only. In a few cases the spokes are indicated by painting with intersecting lines (pl. CCXXII B, *1*).

E. Toy boats

Nature has destroyed all remains of wooden boats sunk if any in the dock. There is still some possibility of tracing impressions of sunken boats in the silt accumulating in the the basin of the dock if further excavation is carried out carefully. In the absence of these remains so far the terracotta models assume great importance in determining the nature and shape of the Harappan boats. A graffiti from Mohenjo-daro depicts a ship with a high prow and stern as also a mast and furled sail. The steerman holds a long oar. It may also be recalled here that an engraving on a seal from Mohenjo-daro represents a sailing ship with a high prow and stern, and was made of reeds. In the centre is a square cabin. Out of five miniature clay models of boats found in the excavation at Lothal only one is complete and represents a ship with sail (pl. CCXX) The latter has a sharp keel, a pointed prow and a high flat stern. Two blind holes are also visible (pl. CCXXIIIA). One of them seen near the stern was meant for the mast, and the other on the edge of the ship may be for steering. (fig. 105, *2*). In the second model, which is rather damaged, the stern and the prow were both curved high up as in the Egyptain boats of the Garzean period.[1] The keel is pointed and the margins are raised. A hole made a little away from the centre was meant for the mast. In this case the prow is broken. Three other damaged models found at Lothal have a flat base and a pointed prow, but the keel is not pointed, nor is any hole for fixing the mast seen. Apparently these flat-based crafts were used on rivers and creeks without sails, while the other two types with sails and sharp keel plied on the high seas and were berthed in the deep waters of the Gulf. Probably the canoe-type of flat-based boats were the only ones which could be sluiced at high tide through the inlet channel of the second stage into the dock as the width of the inlet was only 23 ft. and the depth of the channel 5 ft.

Another type of boat can be guessed from the painting on two potsherds (pl. CLXXV A). It represents a boat with multiple oars (above p. 412) recalling the paintings on the Late Garzean pottery.[2] Boats made of reeds can be seen in the Nal lake near Lothal.

F. Miscellaneous Objects

(i) *Marbles*

Terracotta balls of various sizes are found at all the Harappan sites. Lothal has also yielded them in large numbers. Some of them are perfect spheres, while others are crudely modelled (pl. CCXXIV A). Although a few of them are given a red or chocolate wash,

[1] R. Labaron Bawon "*Egypt's earliest sailing ships*" in *Antiquity,* XXXIV, No. 134, (June 1960), p. 117.
[2] *Ibid,* 118 ff. figs. 2 & 3.

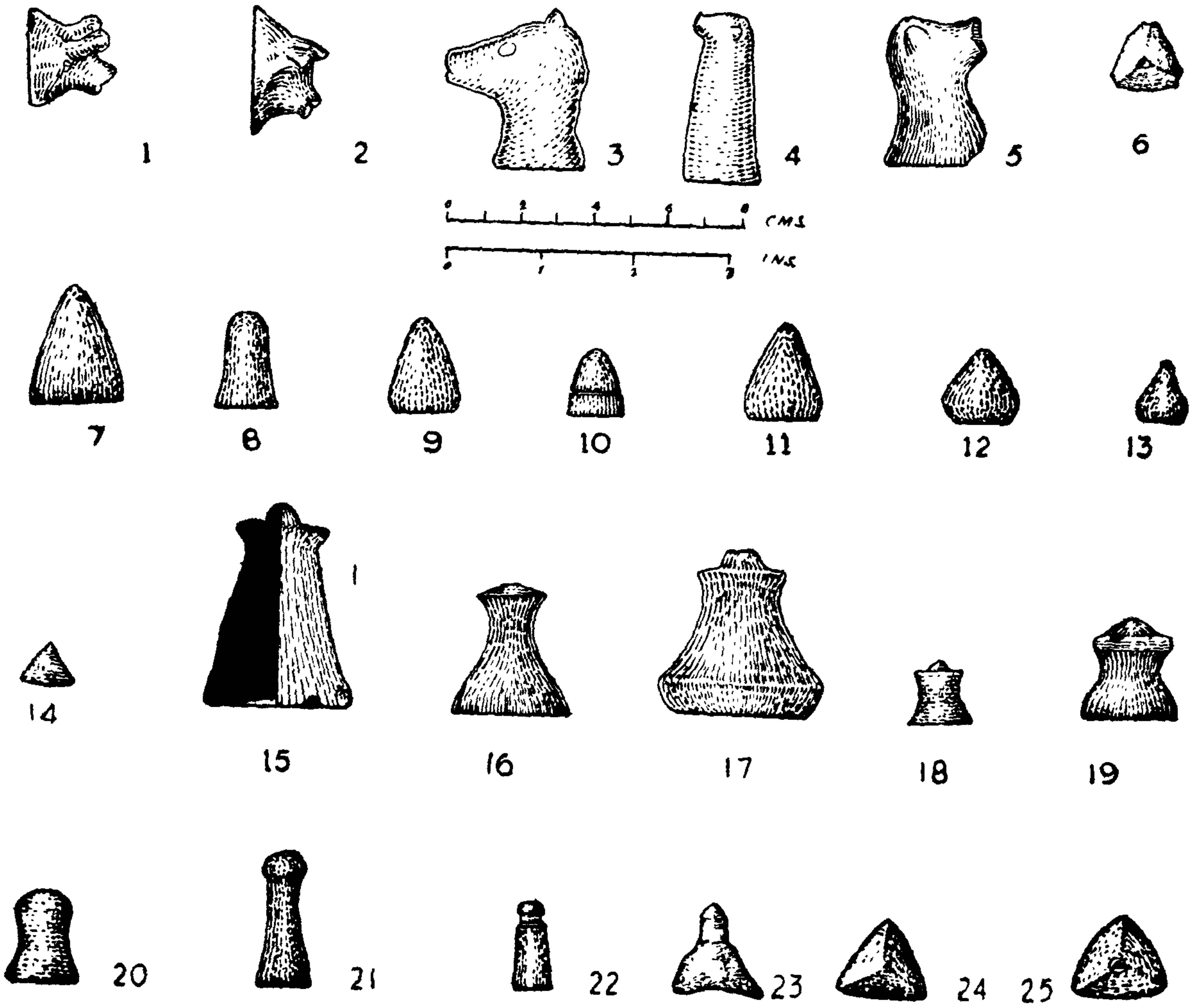

FIG. 103. *Terracotta gaming pieces*

none of them is painted. On the other hand two balls were found decorated with finger nail incisions. The smaller ones must have been used as marbles by children and the larger ones as sling-balls. The possibility of their use for record keeping as in Uruk should also be considered.

(ii) *Spinning tops*

Terracotta bicones with sharp points at both ends and a wide flange at the waist (pl. CCXXIV B *1* to *3*) found at Lothal in considerable numbers are admirably suited for being used as spinning tops by children. It was found possible to wind a thread around the larger ones and throw it for a spin. A smaller bicone with blunted ends (pl. CCXXIV B, *4*) could be made to spin with the help of fingers, while a disk-like object with sharp projections on either side (pl. CCXXIV B, *5*), must have also served as spinning top; but it is not certain whether simple bicones without a large flanged waist (pl. CCXXIV B, *6*) were actually used as spinning tops.

Zoomorphic gaming pieces

Pl. CCXVII B

1. Bull; dull red to grey; ill-baked. Short snout; projecting horns incised eyes, slit mouth, flat circular base. Stylised. From phase IV, Period A (No. 1213). fig. 103 *1*.

2. Bull; other particulars as above. From phase III, Period A, (No. 137), Fig. 103, *2*.

3. Horse; red slip; well-baked; long snout; slit mouth, incised nostrils and sunken eye-sockets; pellet eyes fallen; flat base. A blind hole in the base meant for fixing on a shell tablet. Reslistisc. From phase II, Period A. (No. 831). Fig. 103, *3*.

4. Dog; dull red to grey; ill-baked. narrow pointed snout; slightly pricked ears; circular base. Highly stylised. Crudely modelled. From phase IV, Period A. (No. 12587). Fig. 103, *4*. Resembles a similar gamesman from Tepe Gawra[1].

5. Dog; dull red; moderately baked; thick snout; slit mouth; lop ears; thick neck; circular base. Realistic; From phase IV, Period A. (No. 6974). Fig. 103, *5*.

6. Dog (?); dull red; moderately baked. Short thick snout; slit mouth; short thick ears. Roughly modelled; From phase V, Period B (No. 8298).

Pl. CCXVIII A

Pellets and cones

1. Pellet; pyramidal in shape with imperfect sides; From phase IV, Period A (No. 14210). Occurs at Mohenjo-daro and Ur,[2] also.

2. Pellet; Other particulars as above. From phase V, Period B. (No. 12478).

3. Pellet; roughly tetrahedron with four blind holes in the corners for inlay. From phase III, Period A. (No. 11938). Fig. 103, *6*. Also occurs at Harappa[3] and Ur.

4. Cone; broad circular base and truncated head. From phase IV, Period A. (No. 10896); Fig. 103, 7. Also occurs at Tepe Gawra.[4]

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[1] Tobler *op. cit.* 1950, pl. LXXIVb.
[2] Woolley, *op. cit*, 1934. II, pl. 95, *10478*.
[3] Vats, *op. cit.* 1940. II, pl. CXIV, *40-42*.
[4] Tobler *op. cit.* 1950, pl. LXXXIV, *10*.

5. Cone; narrow circular base and pointed top. Smooth surface. Damaged. From phase I, Period A (No. 1695). Fig. 103, *8.*

6. Cone; narrow circular base and truncated head. From phase I, Period A (No. 1946). Fig. 103, *9.* Fig. 103, *10.*

7. Cone; flat circular base; truncated top; grooved at the waist; From phase III, Period A. (No. 9658). Fig. 103, *10.*

8. Cone; narrow circular base; crude pointed head. From phase IV, Period A. (No. 6124). Fig. 103, *11.*

9. Cone; ledge at the waist; circular base; truncated head. From phase V, Period B. (No. 6990). Fig. 103, *12.*

10. Cone; flat circular base and pointed top. From phase IV, Period A. (No. 1605).

1. Cone; inconspicuous ledge at the waist; truncated head. From phase IV, Period A. (No. 15). Fig 103, *13.*

12. Cone; wide circular base; pointed head. From phase III, Period A. (No. 4578). Fig. 103, *14.*

Castles, tetrahedrons etc

Pl. CCXVIII B

1. Castle; buffish; burnished; circular base; conical body and disc top with a button head; slightly damaged; From phase IV, Period A. (No. 4736). Fig. 103, *15.*

2. Castle; red slip- burnished. other particulars as above, but button head inconspicuous. From phase IV, Period A. (No. 4754). Fig. 103, *16.*

3. Castle; dull red; large circular base; concavo-convex profile, disc top with a button head; squettish From phase V, Period B, (No. 11686). Fig. 103, *17.*

4. Castle; chocolate slip; moderately baked. Other particulars as above but smaller in size. From phase IV, Period A. (No. 8017). Fig. 103, *18.*

5. Castle; dull red; moderately baked. Circular base; concave-convex profile; disc top with large boss; Damaged. From phase II, Period A. (No. 3081). Fig. 103, *19.*

6. Castle; dull red; ill-baked; circular base; concave profile and convex head. From phase V, Period B. (No. 10260). Fig. 103, *20.*

7. Castle; dull red; ill-baked. circular base; conical body; botton top. From phase V, Period B. (no. 11656). Occurs at Mohenjo-daro and Harappa also. Fig. 103, *21.*

8. Castle; light cream wash; moderately baked; circular base; cylindrical body; grooved neck; button top; From phase II, Period A. (No. 198). Fig. 103, *22.*

9. Knobbed gamesman: grey; moderately baked. Rectangular concave base; pointed knob; from Phase IV, Period A. (No. 9021).

10. Knobbed gamesman; grey to dull red; ill-baked; Triangular concave base; pointed knob; Unstratified; Period A. (No. 9022). Fig. 103, *23.*

11. Tetrahedron; moulded; Symmetrical sides with sharp edges; From phase II, Period A. (No. 440). Fig. 103, *24.* Also occurs at Harappa[1] and Mohenjo-daro.[2]

12. Tetrahedron: moulded; burnished. Other particulars as above; large size; From phase IV, Period A. (No. 4753).

13. Tetrahedron: pyramidal shape with an ivory stud in the blind hole on the truncated apex. From phase IV. Period A. (No. 1505). Fig. 103, *25.* Also occurs in the Indus Valley and at Ur[3].

14. Tetrahedron, as above; stud missing from the blind hole. From phase IV, Period A. (No. 4067).

15. Knobbed gamesman; grey; concave: tripod base; From phase IV, Period A. (No. 3459).

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[1] Vats, *op. cit.* 1940, II, pl. CXX, *55-57.*

[2] Mackay *op. cit.* 1938, pl. CXXXVII, *7.*

[3] Woolley *op. cit.* 1934, II, pl. *158a.*

Dice

Pl. CCXIX A

Dice; grey; well-baked; Cube with numbers marked by blind holes on all the six sides as follows:—
1 opposite 2, 3 opposite 4, and 5 opposite 6, slightly worn out due to use. From phase III, Period A. (No. 1606).

Game boards

Pl. CCXIX B

1. Terracotta slab marked with squares of uniform size; From phase. II, Period A. Fig. 104, *1.*
2. Terracotta slab with rectangles subdivided by diagonals. From phase III, Period A. Fig. 104, *2.*
3. Triangular terracotta cake marked with squares and rectangles, subdivided by diagonals. From phase IV, Period A.

Pl. CCXX

Terracotta model of a ship (sail and restored

Pl. CCXXI A

Use of gamesmen demonstrated. Modern chessmen are placed opposite the ancient ones on a modern chess board.

Toy carts

Pl. CCXXI B

1. Toy cart with perforated chassis and detachable cross bar; restored.
2. Toy cart with perforated chassis and axial holes for the central bar. Restored.
3. Toy cart with a solid chassis. Restored.

Cart frames

Pl. CCXXII A

1. Cart frame; red slipped; solid chassis with four vertical holes at each corner for fixing the poles and three pairs of holes in two rows across for fixing the axle with lashings; two more holes on margin for taking the yoke. From phase IV, Period A. (No. 15042).
2. Cart frame; grey; solid chassis square on plan and slightly concave; projections and perforations at the corners for fixing poles and additions; pairs of holes in the centre of either margin for fixing the axle with lashings; a frontal hole for fixing yoke. From phase III, Period A. (14069).

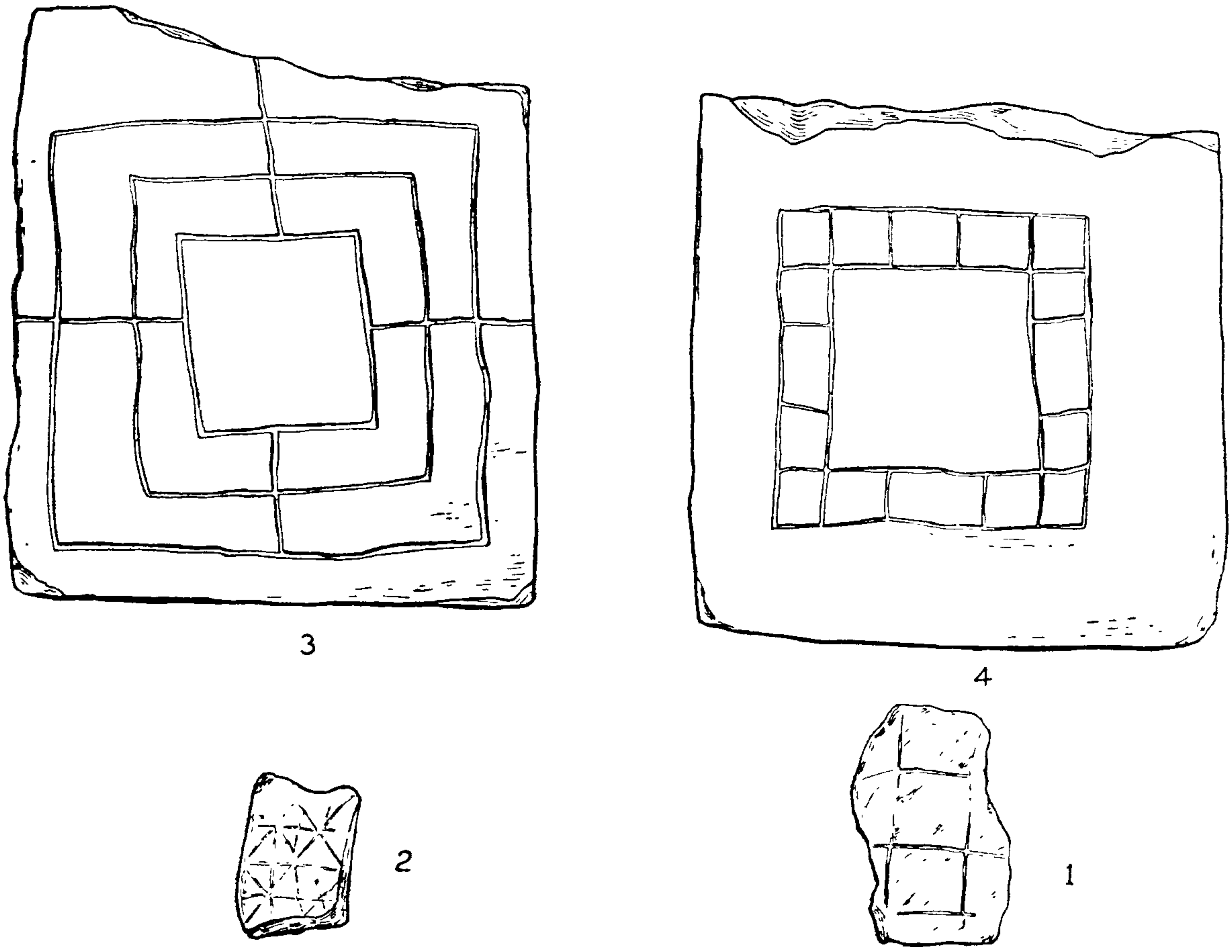

FIG. 104. *Terracotta game boards*

3. Perforated; cart frame; grey; ill-baked. Two cross-bars and a vertical hole in the centre of the margin. Damaged. From phase II, Period A. (No. 430).

4. Perforated cart frame; red slipped and painted in light black with horizontal wavy lines which are now faded. moulded. Two holes in the central cross bar for fixing the axle. Damaged. From phase IV, Period A. (No. 3336).

5. Perforated cart frame; dull red; moulded. Depressions and holes for fixing cross-bars and vertical poles in the centre and at one end. Damaged. From phase IV, Period A. (No. 14534 a).

6. Detachable cross-bar of a toy cart; red slipped moderately baked; moulded; Concave undersurface; two vertical holes for the poles and a transverse hole for the yoke. Painted in black over red with wavy lines. Damaged. From phase A, Period A. (No. 12839).

7. Curved frame; grey to red; ill-baked; Triangular side frame with projection at the base; vertical holes for the poles; a transverse hole for fixing the axle and two other blind perforations for cross bars. From phase III, Period A (No. 3514).

8. Curved frame; dull red to grey; ill-baked; Triangular side frame with a perforation projecting at the base for fixing the axle and three holes for cross bars. Carefully modelled. From phase V, Period B. (No 11647).

9. Concave side frame; creamy wash; moderately baked. Four horizontal holes for fixing the cross bars and two vertical ones for the axle. From phase IV, Period A. (No. 164).

Toy cart wheels

Pl. CCXXII B

1. Wheel with a hub; painted in red over buff slip with two intersecting lines on the exterior suggesting spokes. Moulded; from phase IV, Period A. (No. 15266).

2. Wheel with a very prominent hub and concave interior. Miniature. From phase IV, Period A (No. 11592).

3. Wheel with a prominent hub and painted with intersecting lines in red paint on the exterior; moulded; From phase III, Period A. (No. 13533b).

4. Wheel with a hub; Dull red in colour; miniature; From phase IV, Period A. (No. 12839).

5. Wheel without hub red; made by rubbing potsherd. From phase V, Period B. (No. 14000).

6. Wheel without hub; red; made by rubbing potsherd. Miniature; From phase IV, Period A. (No. 5503).

7. Wheel without hub; made by rubbing a thick potsherd; From phase III, Period A. (No. 12022).

8. Wheel without hub; hand-made; From phase V, Period B. (No. 14430).

9. Wheel without hub; dull red; rounded edges and slightly biconvex section. Hand-made. From phase V, Period B. (No. 9159).

10. Wheel with a prominent hub formed by pinching clay; red; hand-made; From phase III, Period A. (No. 13727).

Boats

Pl. CCXXIII A

1. Boat; dull red; pointed prow; blunt stern; sharp keel and low margins. A blind hole for the mast near the prow and another on margin for a wooden rest for the oar. Unstratified. From phase III. Period A. (No. 15295). Roughly modelled. fig. 105, *2.*

T.C. boat with sail reconstructed. (pl .CXIA)

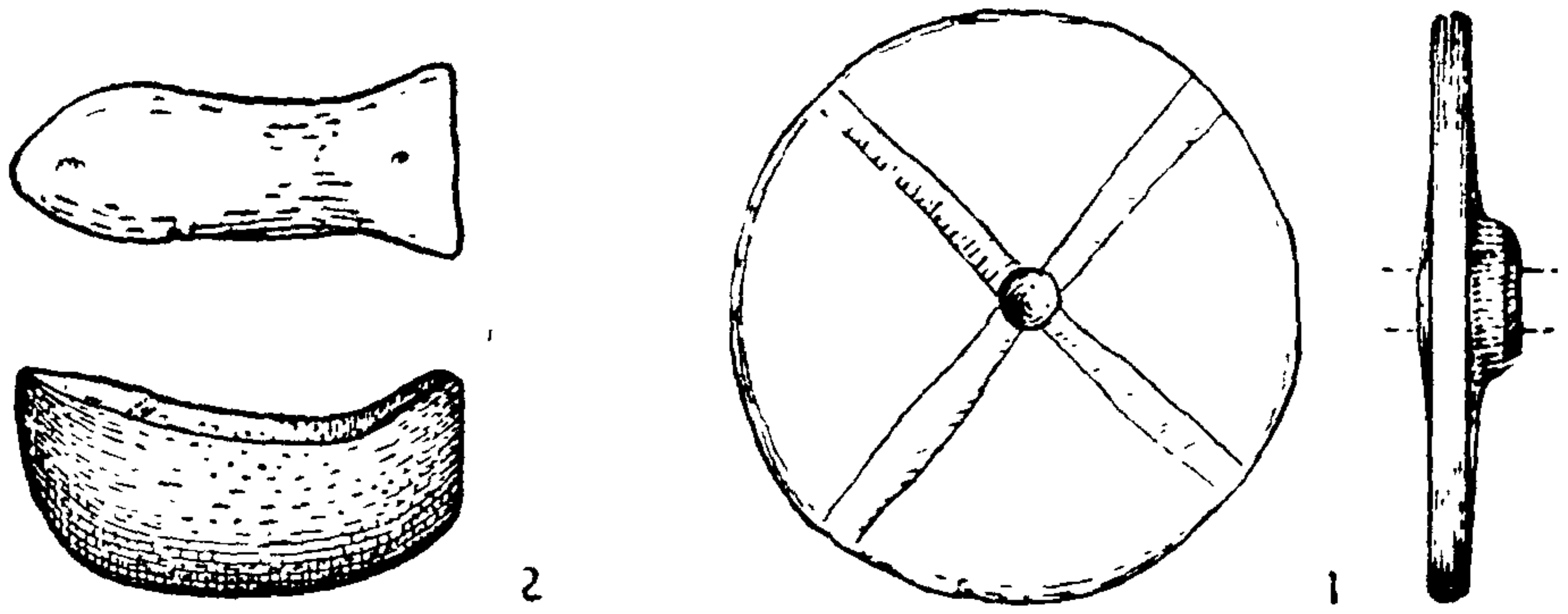

FIG. 105. *Terracotta boat and wheel; Scale ½*

Pl. CCXXIII B

1. Boat; grey; curved prow; sharp keel and high margins. A blind hole away from the centre for the mast. Roughly modelled. Damaged; from phase IV, Period A. (No. 11403).

2. Boat; red; narrow pointed end; flat base and low margins; resembles a canoe; roughly modelled; damaged; From phase IV, Period A. (No. 9564).

3. Boat; red; narrow pointed end; flat base; low margins; resembles a canoe; well-modelled; damaged. From phase V, Period B. (No. 13168).

4. Boat; grey; narrow end, flat base and low margins. Damaged. From phase IV, Period A. No

Disks and marbles CCXXIV A

1. Disk; potsherd; From phase IV, Period A. (No. 10279).
2. Disk; potsherd. From phase V, Period B. (No. 11606).
3. Disk; potsherd; From phase V, Period B. (No. 9984).
4. Marble; brick-red; spheroid; From phase III, Period A. (No. 6016).
5. Marble; red; spheroid; ribbed and decorated with finger-nail incisions over the entire surface; From phase IV, Period A. (No. 3431).
6. Marble; red; spheroid; From phase II, Period A. (No. 1006).
7. Marble; dull red to grey; spheroid. From phase V, Period B. (No. 10714).

Spinning tops

Pl. CCXXIV B

1. Top; red; bicone with pointed ends and flanged waist; From phase III, Period A. (No. 2044).
2. Top; buff-slipped; other particulars as above but a thicker waist; From phase III, Period A. (No. 3983).
3. Top; red; bicone with sharp pointed ends and narrow flanged waist. Damaged. From phase V; Period B. (No. 14711).
4. Top; red; bicone with thick blunted ends and thick waist; cannot spin fast. From phase III, Period A. (No. 3853).
5. Top; grey; bicone with low blunted ends and a large flanged waist; From phase V, Period B. (No. 9137).
6. Top; red; bicone pointed at both ends. From phase IV, Period A. (No. 9271).

Tablets

Pl. CCXXV A

1. Tablet; rectangular in plan and section; Irregular surface; blind holes partially visible; perhaps meant for a solid cart-chassis. From phase IV, Period A, (No. 1510).
2. Tablet; rectangular on plan and section. One end damaged; From phase V, Period B. (No. 9674).
3. Tablet; almost a square on plan and rectangular in section. From phase III, Period A. (No. 8110).
4. Tablet; trapezoid on plan and rectangular in section with slightly raised edges. From phase IV, Period A. (No. 6284).
5. Tablet; almost a square on plan and rectangular in section. From phase III, Period A. (No. 7439).

Discoid Tablets

Pl. CCXXV B

1. Discoid tablet; discoid with slightly raised edge. From phase IV, Period A. (No. 8837).
2. Discoid tablet; discoid; From phase II, Period A. (No. 6136).
3. Discoid tablet; discoid with a concave surface and slightly raised edge, Probably a toy bowl. From phase III, Period A. (No. 10370).
4. Discoid tablet; ovoid with a convex-concave section. From phase IV, Period A. (No. 3604).
5. Discoid tablet; circular with a depression in the centre. From phase V, Period B. (No. 2794).

Miscellaneous Objects

Pl. CCXXVI A

1. Cube; greyish; vertical hole right through in the centre for suspending it with a string. From phase II, Period A. (No. 835).
2. Cube; greyish; From phase III, Period A. (No. 7003).

Pl. CCXXVI B

1. Vessel; hollow cube with a circular mouth; Damaged. From phase V, Period B. (No. 6636).
2. Nail (?) with a flat base; Pointed end damaged; From phase IV, Period A. (No. 12156).

Pl. CCXXVII A

1. Conical object with a flat circular base and truncated top. From phase V, Period B. (No. 15099).
2. Hollow spheroid object; with a small button-head From phase V, Period B. (No. 15019).
3. Tablet; circular on plan and plano-convex in section. From phase IV, Period A. (No. 14685).
8. Tablet; circular on plan and biconvex in section; From phase IV, Period A. (No. 14085).
9. Two-compartmented vessel with a flat, thick base. One compartment deep and the other shallow. Probably used as a muffle. From phase IV, Period A. (No. 15055).

7. PERSONAL ORNAMENTS

A. Introduction

Although the number of personal ornaments in terracotta runs into thousands the bulk of it is accounted for by bangles, bracelets, wristlets and finger rings. Other types of ornaments are very few. Even as the terracotta bangles were used on a large scale shell bangles too were popular. The reason for finding very few personal ornaments in terracotta except bangles is that the Lothal people could afford to buy costlier ornaments in shell, copper, bronze, silver, gold and semi-precious stone.

The ornaments can be broadly classified into ear-ornaments, head-ornaments and and.wrist-ornaments.

B. Ear-and Head-ornaments

The most popular type of ear-ornament is a pulley-shaped biconical object with flat circular top and base (pl. CCXXVII B). A horizontal perforation for suspending it from

the ear by means of a chain, is can be seen. This ornament is invariably painted with intersecting lines or spoked wheel designs in black over red or chocolate over green or buff. The size varies from 1.5 ins. to 2 ins. in diameter (disc). Sometimes the waist is narrow and long but in many cases it is broad and short. A distinction can also be made on the basis of the ratio of diameter of the top to that of the base. In some cases both are equal, while in others the base is narrower than the top. A few ornaments have a depression in the base. It is held by some textile experts that these pulley-like objects were used as whorls. Secondly, examples of pulley-like objects in agate and terracotta covered with gold-foil and used as ear-ornaments have been found at Taxila[1] and Prabhas.[2] Ear ornaments of this type in gold and semi-precious stone are currently used in India.

Two types of hallow conical ear-pendants, one of them with perforations on the margin and the other with a loop in the interior for suspending them by means of a chain (pl. CCXXVIII, *1-4*) are noticed in terracotta as also in copper and gold. A similar type is used now-a-days also, more as a head-ornament than as an ear-pendant.

A star-shaped object of cogwheel type with a stud in the centre for fixing it in the perforated ear-lobe is an interesting type from Lothal (pl. CCXXVIII, *5-6*). The teeth in the cogwheel vary in number from 8 to 11. Similar ornaments are found in faience and steatite also.

A small but beautiful ear-stud of floral design with four petals and teethed margins deserves special mention (pl. CCXXVIII, *7*). The stud at the back is meant for fixing it in the ear-lobe my means of a pin in the vertical hole. The purpose of having an axial hole may be for suspending the conical pendant mentioned above with a chain passing through it.

Hollow conical-pendants occur in gold at Lothal and Mohenjo-daro in Harappa levels,[1] and at Chanhu-daro in Jhukar levels.[4] The looped sub-type occurs in faience at Harappa.[5]

Bud-shaped objects in terracotta with a short tang found at Lothal appear to have been used as ear-studs. Similar objects found at Harappa and Mohenjo-daro are considered to be nose-studs. Such thick ones are normally used in the ear, but not on the nose.

Fan-shaped terracotta objects with a tang and decorated with incised patterns appear to have been used as hair pins by inserting a wooden or copper pin in the vertical hole noticeable in the tang. The holes in the margin suggest that these objects could be suspended from the ear. Alternately smaller pins of copper etc., were inserted in these holes. The mother-goddess figures are found wearing similar objects on the head. Fan-shaped hair-pins of ivory and pith are used in India even today. Similar ornaments in faience but without any tang or decoration are found at Harappa.[6]

C. Bangles

They can be broadly classified into three main types. The most common type has a round section varying from 0.25 ins. to 0.75 ins. The second type is bracelet or bangle with a triangular section and is often treated with a red or brownish slip. The third one is a wristlet or bracelet with an indented exterior. It is, however, difficult to distinguish between

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[1] Sir John Marshall, *Taxila* (1951) II, pl. 136.

[2] *Indian Archaeology*, 1956-57, *A Review* pl. XVIII, *1*.

[3] Marshall *op. cit.* 1931, III, pl. CXLV, III, *A2*.

[4] Mackay *op. cit* 1943, pl. XXIX *67-68*.

[5] Vats, *op. cit.* 1940, I, pl. CXXXVIII-*29*.

[6] *Ibid.*

a bangle and wristlet. Hence the section and decoration are taken as the main criterion in describing them.

The internal diameter of the bangles and wristlets varies from 1 in. to 2.5 ins. the smaller ones being used by children. In making them the ends of a roll of clay were normally joined by over-lapping. It is interesting to note that the terracotta bangles were not popular in the later levels of Lothal and Rangpur indicating thereby that they were going out of fashion. In this connection the replacement of terracotta bangles by shell bangles at Rangpur may be noted.

Ear and head-ornaments

Pl. CCXXVII B

1. Ear-pendant; red; well-baked. Circular top and base with narrow waist; painted in black over red with double intersecting lines on top and horizontal bands on the waist. From phase IV, Period A. (No. 14072).
2. Ear-pendant; buff slip over red ground; shape as above; painted with horizontal band on the base and rim. From phase V, Period B. (No. 14673).
3. Ear-pendant; buff; well-baked. Shape as above. Painted in chocolate over buff with six arcs on the top and eight vertical bands on the waist. From phase IV, Period A. (No. 11624).
4. Ear-pendant; dull red; moderately baked. Squattish; Damaged. From phase V, Period B. (No. 3947).
5. Ear-pendant; chocolate slip; moderately baked; Broad convex-base; shallow grooves and narrow circular top. Damaged. From phase IV, Period A. (No. 2426).
6. Ear-pendant; dull red to grey; moderately baked. Shape as above; depressions in the circular base and top. From phase IV, Period A. (No. 11042).

Pl. CCXXVIII

1. Pendant; buffish; ill-baked; Prominent ledge between hemispherical top and bottom and axial hole for suspension; Could be suspended from ear-stud or necklace. From phase V, Period B. (No. 11190).
2. Pendant; grey; ill-baked; Hollow cone with a projected rim and loop ring on the interior. Can be suspended from the ear-lobe. From phase IV, Period A. (No. 12912). Fig. 106, *2*. Occurs in Harappa[1]. Similar gold ornaments are used on the forehead in Gujarat and Rajasthan.
3. Pendant; paring mark visible on the red slip; hollow cone; pointed and slightly curved at the tapering end; six holes along the rim of the base for being suspended by means of string. From phase IV, Period A. (No. 10922). Occurs in the Jhukar-levels of Chanhu-daro.[2]
4. Pendant; light red to grey; ill-baked. Hollow cone with a projecting rim; imperfectly perforated on the tapering end; From phase IV, Period A. (No. 5759). Occurs in gold at Lothal (pl. CCXCVI, B, *10*) and Mohenjo-daro.[3]
5. Ear-stud; red slip; moderately baked; cog-wheel type with eight teeth-like projections and a stud at the back for fixing in the ear-lobe. From phase IV, Period A. (No. 14473).
6. Ear-stud; light red; well-baked. Cogwheel with ten teeth-like projections and a stud at the back. Damaged. From phase IV, Period A. (No. 12209).

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[1] Vats, *op. cit.* 1940, II, pl. CXXXVIII, *29*.

[2] Mackay, *op. cit.* 1943, pl. XXIX, *68-68*, p, 1.98

[3] Mackay, *op. cit.* 1938, II, pl. CXXV, *28;* I. p. 259.

7. Ear-stud; red; well-baked. Floral design with four petals and a knob at the back; ten blind holes in between the petals. Two axial holes meant for a vertical pin or for suspending a pendant by means of a chain. Well modelled. From phase IV, Period A. (No. 6919)

8. Head of hair pin; dull red; moderately baked; fan-shaped and decorated with incised design. Vertical hole in stud meant for fixing a rod. Could also be used as pendant. From phase III, Period A. (No. 15032). Occurs at Mohenjo-daro.[1]

9. Head of hair-pin; dull red; other particulars as above. From phase III, Period A. (No. 15032b).

10. Ear-stud; buff to red; well-baked; bud-shaped with a short tang. From phase III, Period A (No. 6008). Occurs in Chanhu-daro also.[2]

11. Ear-stud; grey; moderately baked; bud-shaped with a long tang; Unstratified. Period A (No. 12960).

12. Ear-ring; grey to light red; moderately baked; Rectangular section with a large hole for suspension. From phase III, Period A. (No. 2172).

Pl. CCXXX

1. Bangle; circular in section. From phase II, Period A. (No. 12092).
2. Bangle; circular in section; perhaps used as ear-ring; From phase I, Period A (No 5174).
3 Bangle; dull red; circular in section; From phase III, Period A (No 15183).
4 Bangle; scalloped; From phase III, Period A, (No, 5595)
5. Bangle; scallopped; From phase V, Period B (No. 10745).
6. Bangle; scalloped; From phase V, Period B. (No. 2384).
7. Bangle; triangular in section. From phase III, Period A. (No. 11356).
8. Bangle; circular in section; damaged. From phase IV, Period A. (No. 10802).
9. Bangle; circular in section; damaged; From phase II, Period A (No. 12325).
10. Bangle; triangular in section; burnished; from phase III, Period A. (No. 5979).
11. Bangle; circular in section. damaged; From phase V, Period B. (No. 10066).
12. Bangle; triangular in section. From phase II, Period A. (No. 2921).
13. Bangle; triangular in section; burnished; From phase V, Period B. (2487).
14. Bangle; triangular in section; burnished. From phase IV, Period A. (No. 2155).

8. OTHER TERRACOTTA OBJECTS

A. Balls and Pellets

A large number of burnt clay pellets of various sizes and shapes (pl. CCXXIX, A) have been found in all the phases of occupation at Lothal in houses, streets, fire-altars and in big jars along with bone, ash and terracotta triangular cakes. A few of them have come to notice u the burial pits as well (pl. CCXXIX, A. In the cutting SRG 6 the terracotta balls were found spread all over the floor (pl. LXXXVI, A) of a house.

The size of the balls and pellets varies from 1.5 to 4 ins. in diameter. On the basis of their shape they are grouped under three heads. The first group consists of cubes or cuboid pellets with two or four finger impressions on the sides. The second group includes spheres and ovoid pellets with or without finger marks and the third group consists of ovoid pellets bearing four finger impressions, all on one side only. A careful examination reveals an evolution of the shapes from the cubes and cuboids in Period A to ovoids in Period B. In

[1] Mackay, *op. cit.* 1938, II, pl. CVII, Z.8; pl. CXL, *40;* I. p. 544.
[2] Mackay, *op. cit.* 1943. pl. XXIX, *69.*

phases II and III the cuboid pellets with two finger marks, one on each side, are found in abundance. The ovoids and spheroids are very rare in phases III and IV. Finally, cuboids are replaced by ovoids.

Pellets were also found along with triangular 'cakes' in the fire-altars at Lothal. At Kalibangan, too, they are said to occur in circular enclosures with a central altar. Similar pellets are reported from Tepe Gawra in the temple well of Stratum VIII. According to Tobler they were used in some kind of religious ceremony connected with the temple.[1]

Marshall and Vats have considered pellets as weapons of offence and defence. Small pellets without finger marks can be slinged off from a bow just like a trajectory. The bigger ones with finger marks lend themselves to a steady grip for a vigorous throw. It can be a formidable weapon in the hands of a skilled user. Hence it is believed that the spheroids were used as sling-balls. The cuboids with four finger-marks must have been used as weights for fish-nets as is done even now in India. The ovoids with or without finger-marks seem to have served a ritualistic purpose. They were also occasionally used for floor-fillings and as 'road metal'. In one of the houses in Block E a floor was made up of broken 'cakes' and 'cubes'. T. C. cakes were used for decoration of the floor or in providing perforated ventilators The possibility of the cakes having served the purpose of weights was also considered, but they do not conform to any standard and the variation in weight from one cake to another is so eratic that no ratio can be arrived at. 'Cakes' found in fire-alter remind us of *dvādaśa puroḍāśa* offered on potsherds in Vedic sacrifices. The Kalibangan cake has a sacrificial scenee engraved on it.

Sling Balls

Pl. CCXXXI A

1-7. Pellet, ovoid without finger cuts. From phases III-IV. Period A.

Pl. CCXXXI B

1-6. Net sinkers of medium size; ovoid; four finger cuts, one on each side for tying the sinker to the net by means of a string. From period A.

Pl. CCXXXII A

1-6. Net-sinkers of large size; cuboid; four finger-marks; From Period A.

Pl. CCXXXII B

1-6. Net-sinkers; ovoid with four finger marks produced by pressing in the palm. From Period B.

Spheroids and triangular cakes

Pl. CCXXXIII

1. Pellet; spheroid with basket impression on surface; From phase III, Period A.
2. Pellet; spheroid with basket impression. From phase II, Period A.

[1] Tobler, *op. cit.* 1950, p. 168.

3. Triangular cake with graffiti mark. From phase III, Period A.
4. Triangular cake with two intersecting lines. From phase III, Period A.
5. Triangular cake with a circular grooves in the centre. From phase IV, Period A.
6. Triangular cake with a circular groove in the centre. From phase IV, Period A.
7. Triangular cake with graffitti; Indus sign- From phase IV, Period A.
8. Cake almost discoid. From phase III.
9. Cake cuboid. From phase V.

Pl. CCXXXIV A

1-10. Triangular cakes of various sizes. From phases I-IV, Period A.

Pl. CCXXXIV B

Terracotta scale-pans used in a weighing scale.

CHAPTER XIX

COPPER AND BRONZE OBJECTS

1. INTRODUCTION

The copper and bronze objects from Lothal can be divided broadly into five categories namely, tools, weapons, personal ornaments, objects of domestic use and figures. The line of distinction between tools and weapons is very thin because certain tools such as axes can be used as weapons for offensive or defensive purposes. The personal ornaments form the bulk of the copper objects which are nearly 1500 in number, but it has not been possible to determine the shape and use of more than one thousand objects because of corrosion.

Copper beads and seals are dealt with separately. Some observations on the technique of refining and melting of copper, casting of certain categories of objects and on the sources of supply of the two main ingredients of bronze are made below.

Prof. Piggot says that the metallurgy of copper and its alloys as practised by the Harappans was one of competent dullness,[1] while Mackay is of the opinion that the Indus people did not know how to mix tin with copper for making bronze and that they imported bronze. He further adds 'the percentage, however, varied so much for individual specimen that it was obvious that the mixing of the two metals was performed in most perfunctory manner'.[2]

2. TECHNIQUE

A. Copper Ingots

Mackay himself has listed three copper ingots from Mohenjo-daro,[3] which indicates that copper was imported. This fact is substantiated by the discovery at Lothal of a bun-shaped ingot which contains 99·81 per cent copper and no tin or any other alloy. Out of eight lumps from Mohenjo-daro which Mackay considers as ingots, three are of copper.[4] They are plano-convex in shape closely resembling the ingot from Lothal (fig. 118, 4, pl. CCXLVII A). They were also found in a house which is considered to be the quarter or workshop of a metal-worker. The concave under-surface of the ingots suggests that the pit in which they were run had a convex floor, while the lugs in two cases indicate that the reduced metal was not allowed to run directly into the hole but first passed along a narrow channel. The ingot from Susa (pl, CCXLVII B) and Lothal also have a concave under-surface and short projections. In most cases the surface is puckered as in the case of those from Mohenjo-daro. Others referred to by Mackay are either 'melts' broken up from copper ingots for easy melting or bronze castings. In the earlier excavations Marshall noticed three 'lumps of crude copper, plano-convex in shape, 6 to 9 inches in diameter and 1 to 1·5 inches thick in the centre.[1] Obviously, they

[1]Piggot *op. cit.* 1961, p. 200.
[2]Mackay *op. cit.* 1943, p. 174.
[3]Mackay *op. cit.* 1938 p. 451.
[4]*Ibid.* pl. CXXXII, *37-38.*

are also copper ingots of the type found at Lothal. According to him they were produced by the smelting operation in a primitive furnace consisting simply of a concave depressionin the ground.

B. Melting

The crude metal was normally re-melted for refining in clay crucibles, which were then broken up for the recovery of the purified metal. A crucible similar to the one from Lothal with traces of slag was recovered at Mohenjo-daro. Mackay refers to ingots from the Harappan levels of Chanhu-daro, but one of them, a long round bar,[2] appears to be a casting and not an ingot. The second specimen is, however, a bun-shaped (plano-convex) ingot[3] of the type from Lothal. From these details it is clear that Lothal and Mohenjo-daro imported copper ingots. In the absence of any evidence of smelting the ore at any Harappan site in India it appears that the metal was smelted somewhere else. Marshall suggests that crude copper was refined in the Indus Valley. Lothal, however, appears to have refined crude copper or imported refined (99·81 percent) copper and re-melted it for making tools etc.

C. Casting

Most of the copper and bronze objects were obviously made by casting, but a few were shaped and finished by hammering. Axes and chisels were heated and hammered after casting until they reached the atmospheric temperature. Thus it is evident that forging was well known to the Lothal smiths.

Chanelled crucibles with thick walls of clay mixed with sand were used for casting long bars which were subsequently hammered into chisels, rods etc. The thicker bars appear to have been cut into thinner ones as indicated by the grooves on some of them.

The reason for not casting socketted daggers, arrow-heads and shaft-hole axes is often attributed to the nonuse of closed moulds of more than one piece. But it may be noted here that the use of closed moulds of more than one piece was made in casting figures in *cireperdue* technique. As an industrial and trading community the Harappans devoted more attention to the improvement of the tools needed by carpenters, shipwrights, copper-smiths and lapidaries than to the production of more advanced types of offensive and defensive weapons. This can be inferred from production of advanced tools such as the curved saw with teeth (fig. 114, 11; pl. CCXLI-C), the auger-bit with twisted grooves (fig. 112, 1; pl. CCXXXIX B, 1), the plainer-bit with concave margins, the needles with eyelet at the piercing or flat-end, and the crescentic sleeved (pl. CCXXXVI A) axe. The personal ornaments consisting of the corrugated bangle (fig. 115, pl. CCXLI B) the amulet with a crouchant bull-figure (fig. 117, 1; pl. CCXLIII A) the bird-headed pin (fig. 117, 5; pl. CCXLV A) and the pendants and rings received the special attention of the coppersmiths of Lothal.

This does not mean that they were totally ignorant of advanced tool-types. The spearhead with a folded socket and rivet-hold found at Lothal (fig. 108; pl. CCXXXVI) closely resembles the one from Middle Minoan III, while the transverse axe with shaft-hole (fig. 106, 5-7 pl. CCXXXV A) is reminiscent of similar ones in Susa B and Susa C. The tanged chisel from Harappa and Mohenjo-daro are in no way inferior to the Sumerian

Marshall *op. cit.* II, 1931 p. 485.
[2]Mackay *op. cit.* 1943, p. 187.
[3]*Ibid* p. 186

chisels of the Sargonid Period. It must, however, be admitted that the flat axe, the dagger-head with a thin flat blade and flat tang used by the Harappans were out-moded. One possible explanation for this kind of conservatism exhibited in the preparation of weapons is that they had no military class to be supplied with weapons on a large scale. Engaged as they were in peaceful avocations. They concentrated on the production of ornaments, figurines and tools for craftsmen. This fact is also borne out by the use of bronze for making mirrors, bangles and rings rather than axes, chisels, daggers and spear-heads.

Secondly production of an alloy of more pleasing colour and lustre appears to have been one of the chief considerations in using tin with copper in making ornaments.

D. Kilns

A circular kiln of mud-bricks 6 ft. in diameter and 2 ft. 3 in. deep uncovered at Lothal near the coppersmith's workshop appears to have been used for remelting ingots, as suggested by an earthen bowl found here. The mud-plaster on the inner surface of the walls has vitrified due to intense heat. Large sheets of metallic copper reduced to copper carbonates due to prolonged mineralisation on account of the saline soil (pl, CCXLIX A) have been recovered in the form of flattish chunks from the vicinity of the smithy. It is also likely that when the ingots were being melted some accident took place as a result of which the molten metal flowed over the ground. The smithy was situated near the nullah on the northern fringe of the town so as to ensure abundant supply of water. The anchor stone found on the brick-embankment of the nullah (pl. CCLXI A) indicates that boats were anchored here possibly for unloading the heavy metals.

Inspite of the destructon of the town in phases III and IV as a result of the flood, the coppersmiths re-establishied their workshop near the nullah in phase V. Five small rectangular sink-like brick-pavements skirted by bricks-on-edge and interconnected with runnels (pl. LIV B) are laid bare in the workshop wherein several coppersmiths must have been working under a single roof. Near each sink a pot-furnace containing ash and bits of muffles are noticed. The sinks are too small (3 × 2·6 ft.) to be used as bathing pavements. Among important finds mention may be made of two terracotta crucibles, small lumps of copper and a crescentic sleeved axe used for shaping copper and bronze objects. It bears hammer marks.

In one of the rooms of a small mud-brick structures (151) in street 1 of the Lower Town, a rectangular furnace of burnt-bricks placed on end and measuring 3 × 3·5 ft. and 1.05 ft. deep has been laid bare (pl. XXXVII A). A cubical stone showing signs of use as an anvil is still *in situ* near the kiln. The contents of the kiln were ash and fragments of terracotta crucibles. A stone mould (pl. CCLIIB) used for casting pins and awls, a copper pin, a broken copper chisel and a hammer-stone with a socket for hafting (pl. CCLIII A) are among other finds from the workshop and its vicinity. The two kilns noticed by Mackay in his excavations at Mohenjo-daro[1] closely resemble the circular kilns, also two in number, found at the northerm end of the town. At both the sites the kilns do not have any vent. They appear to have been used for melting the ingots in open bowls.

Two other types of kilns have come to notice at Lothal. One of them built near the workshop of lapidaries in Block F is circular on plan and has four interconnected flues in the floor of the upper chamber fig. 12; (pl. XCI A). Fuel was supplied through the long mouth and perhaps a bellow was used for draught. A dump of calcined ash noticed near the kiln indicates that cowdung and charcoal were used as fuel. It is not known whether any vaulted roof surmounted the walls, nor is there any indication of an opening for introduc-

[1]Mackay *op. cit*, 1938 I, 49-50; pl. XXV (a).

ing objects to be fired or melted. No trace of a chinmey for the smoke to escape could be traced as the walls have disappeared. The occurrence of several baked beads and pebbles of agate and carnelian in and near the kiln indicates that the structure was used by the lapidaries for baking raw materials as well as the finished product. Owing to intense heat, the mud-and-sand plaster on the walls has also vitrified. But the possibility of the kiln having been used by coppersmiths for re-melting copper need not be ruled out. Another oval-shaped kiln with mud-plastered walls laid bare in Block F is heavily damaged, leaving no trace of the roof, if any, The brick-stump in the centre of the kiln was meant for keeping a bowl or pan in which the paste was vitrified.

Vats has reported sixteen furnaces[1] which are grouped under three categories. One of them is a pot-furnace, the second type is a cylindrical pit dug in the ground with or without bricklining and the third type is a pear-shaped pit dug in the ground with or without bricklining. The excavator has suggested that the last type was designed for casting of metal objects. A pear-shaped furnace was found by Mackay at Mohenjo-daro also.

E. Mixing

Table XVI reveals that low-tin bronze was used for making pins, mirror, rods chisel, flat axes, daggers and arrow-heads and high-tin bronze for bangles and pins. The hardening property of lead was also known to the Lothal folk. They made use of this knowledge in hardening tools having sharp edges. Tin became a rare commodity in Sumer by 2700 B.C. until it could be had once again by 1500 B.C.[2] Sayce says that tablets from Kara Huyuk refer to tin which was a rare and precious metal in Babylonia in c. 2500-2200 B.C. It is perhaps during this period that bronze was being introduced in the Indus Valley and Kaithiawar by the Harappan traders. Hence it had to be very sparingly used. Out of 71 copper objects from Lothal examined in four lots by Lal the tin contents in two bangles were 11·20 to 11·82 per cent (below p. 527). One grooved rod contained 9·02 per cent, a mirror 5·47 per cent, a pin 13·80 per cent, two chisels 9·02 to 9·62 per cent, an engraver 3·96 per cent, and a spear (knife?) 2·27 per cent of tin. Thus only eight out of 71 objects may be said to have contained an appreciable quantity of tin. A sleeved axe used for fashioning copper objects contained 2·51 per cent lead, while a fish-hook contained 1·30 per cent of the alloy. An unidentified object contained 1·64 percent lead. On the other hand, a flat axe (celt) from Rangpur II A contained 4·09 percent tin, and a needle 6·78 percent. There was no tin-mixture in Rangpur II B while three out of four objects examined from Rangpur II C contained tin varying from 11·07 percent in a bangle to 2·60 percent in an axe. One of the knives contained 5·28 percent tin. It is therefore very interesting to note that supply of tin had increased in Period II C while it was poor in Period II A and practically nil in Period II B as can be judged from the scarcity of tools of copper and copper-alloys during the late Harappan (Lothal B and Rangpur II B). Period.

The analysis of copper objects from Harappa and Mohenjo-daro has further revealed that the Harappans used a copper-a rsenic alloy comparable in hardness to low-tin bronze.

[1]Vats *op. cit.* I, 1940, p. 470.

[2]Marshall *op. cit.* II, 1931, p. 482.

Table XII—Ingots from Susa

Group	Diameter	Weight	Copper / Bronze	Contents
1.	6·2 cms	0·330 kg.	Bronze	Copper alloyed with tin (15%) with traces of lead, iron, arsenic, silver, antimony and calcium
2.	5·6 cms.	0·148 kg.	Copper	Copper and silver in high proportions; also traces of gold, lead, tin, antimony, magnesium and calcium.
3.	10 cms.	1·885 kg.	Copper	Mostly copper with traces of aluminium, iron, lead, magnesium, arsenic, silver and calcium.
4.	13 cms.	1·550 kg.	Copper	Mostly copper with traces of iron, lead, magnesium, arsenic, silver and calcium.[1]

The Mohenjo-dara ingots (Table XIII) weigh 623.7 g and 1,007.3 g.

The incidence of the detrimental elements in the copper ore from the Madhan-Kudhan section, Khetri Copper Belt is as follows:[2]

Lead: Generally occurs as traces, the highest percentage noted is 0·18.
Zinc: Generally occurs in the second place of decimal. The highest percentage noted is around 0·18%
Arsenic: Generally occurs in the fourth place of decimal, the highest record is around 0·06%
Cobalt: Around 0·01%
Nickel: Around 0·05%
Iron: 15% to 20%

Stray finds of bun-ingots are reported from Cyprus, Crete and Ras Sharma, but the ox-hide type was more common in Anatolia and Mesopotamia.

A. Tin

Tin occurs in Hazaribagh district of Bihar but it cannot be worked. Beyond the Indian borders it is found in large quantities in the Malayan peninsula and Tanasserin Division (Tavoy and Merui districts) of southern Burma. Cassiterite (tin oxide) occurs in Banaskantha district of Gujarat, Dharwar district of Mysore and Rewa district of Madhya Pradesh, but it is noticed in recent times only. It is also found in China and in Kuh Banan and Kara Dagh in Persia.

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[1] I am greatly indebted to Mr. Pierre Amiet for having kindly furnished information regarding the chemical composition etc., of the ingots.

[2] I am grateful to the Director, Indian Bureau of Mines, Nagpur, for the information kindly supplied by him.

Table XIII

Site and Object	Copper	Tin	Antimony	Arsenic	Iron	Nickel	Lead	Sulphur	Oxygen by difference
Copper lumps (ingots) from Mohenjo-daro No. 39.	96·67	—	0·88	0·15	0·03	1·27	0·02	0·98	
	97·07	—	Tr	0·98	0·49	0·31	Tr	1·15	
	96·42	—	—	—	—	0·35	0·09	0·36	2·78
Bronze lump (?) from Mohenjo-daro[1] No. 34.	83·92	12·13	Tr	—	—	0·17	0·17	—	3·61
Copper ingot from Lothal A[2]	99·81	—	—	—	Tr	Tr	—	—	

[1] Mackay 1938 II, pls. CXXI, CXXXII.
[2] Report of the Archaeological Chemist, See below p. 527

Table XIV

LOTHAL								RANGPUR							
Period A	Anti-quity No.	Object	Copper	Tin	Lead	Nickel	Iron	Period II A	Anti-quity No.	Object	Copper	Tin	Lead	Nickel	Iron
Phase I	1344	Bangle	94·90	—	—	·45	2·14	,,	663	Celt	91·35	4·09	Tr	Tr	
II	8110	Chisel	88·53	Tr	—	Tr	Tr		141	Needle	65·40	6·78	—	0·51	0·24
III	14535	Ingot	99·81	—	—	Tr	Tr		260	Bead	96·60	Tr	—	0·38	1·40
IV	10918	Sleeved axe	96·27	—	2·51	Tr	Tr		635	Finger Ring	96·10	Trt	—	Tr	Tr
IV	5957	Celt	97·18	Tr	—	·31	Tr								
IV	12343	Bangle	74·35	11·20		Tr	Tr								
	324	Arrowhead	97·21		—	Tr	Tr								
	6042	Fish-hook	99·01		—	·08	Tr								
	11893	Chisel	88·53	—	—	Tr	Tr								
	13886	Rod with grooves	57·75	9·02	—	Tr	Tr								
	15030	Mirror	54·78	5·47	—	—	Tr								
								II B	442	Pin Rolled head	96·60	Tr	—	0·80	1·86
Period B	3091	Shaft Balance	88·27	—	—	·19	Tr	II C	324	Celt	91·20	2·60	Tr	2·10	
									417	Knife	94·80	0·70	—	0·40	Tr
									526	Knife	59·00	5·28	—	—	Tr
									437	Bangle	86·40	11·07	Tr	1·80	Tr
								III	330	Bangle	91·80	0·60	—	5·88	1·88

Table XV

Site and material	Copper	Lead	Nickel	Arsenic	Tin	Antimony	Iron	Sulphur	Remarks
Nal Cemetery—Copper	93·05	2·14	4·80	Tr					
Harappa-copper	96·7	0·02	1·27	0·15	—	0·88	0·03	0·98	
Harappa-Bronze	85·37	Tr	0·16	0·07	11·09	Tr	0·18	0·11	
Harappa-copper-Arsenic	94·76	0·26	0·14	4·42	0·09	—	0·15	—	
Mohenjo-daro—Copper Ore (?)	76·15	Tr	0·23	0·37				1·12	Insoluble matter 4·80

It may be added here that lead and lead objects were also found in the excavations.

4. TOOLS AND WEAPONS

A. Axes

Three main types of blade-axes are found at Lothal. The first type consists of a flat axe with a long narrow blade or a broad one while the second type has a thick triangular section. The crescentic axe with sleeved margins forms a separate category. The flat celts from Lothal and Rangpur are almost identical with the celts from the Indus valley. The second type must have had a shaft hole, but it is broken.

Two sub-types of flat axes can be made out in the first group. One of them has a long narrow blade and another a broad one with slightly concave margins (figs. 106 and 107).

(i) Axe with a long narrow blade

This type occurs frequently. Its blade is invariably double-sloped at the cutting edge and sometimes slightly splayed but straight, the butt being straight-cut or slightly rounded. The sides are parallel and the body is more or less uniform in dimension except in one case (No. 11960), where it is tapering towards the butt-end. This type of blade-axe has a wide distribution. It occurs in Susa D,[1] in the upper levels of Mohenjo-daro and at Chanhu-daro.

(ii) Axe with a broad blade

This type has a broad short blade and a splayed convex working edge (fig. 107, 1-2; pl. CCXV B). A slight concavity of the margins near the cutting edge is also noticeable. Some of the axes from Mohenjo-daro are larger in size Flat celts engraved with a bird motif, probably a peacock, found in Saurashtra are now lying in the Watson Museum, Rajkot. The blade in this case is 7½" long, 4¾" wide and ¼" thick.[2]

The axe was first cast and subsequently hammered and finished with an abrasive. The early flat axes from Mohenjo-daro are said to have a more conspicuous splay and concave margins than is the case with those from the late period when old blades themselves were recast and minimum splay was kept to increase the working ability. The margins were also made parallel.

The second sub-type with a square blade and slightly convex edge became more popular in the Late Harappan and post-Harappan periods. Similar ones are found in Lothal A, Rangpur II A and II C, Prabhas II and Rojdi I.

(iii) Axe with a triangular section

This type of axe has a short blade with a triangular section and at least one out of three found at Lothal appears to have had a shaft hole. In all the cases the upper portion is broken. One shaft-hole axe each was found at Mohenjo-daro, Harappa and Chanhu-daro in the late levels. They are double-sloped and have minimum splay at the

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[1] *Delegation en Perse Memoires* Pl. I, fig. 11-12.

[2] M. G. Dikshit in *Vallabh Vidyanagar Research Bulletin* Vol. . I, No. I, p. 23-24.

cutting edge. The margins are slightly concave. All the three specimens from Lothal appear to have been cast and hammered subsequently.

(iv) Crescentic sleeved axe

This is a rare type which is not found in any other Harappan site. The axe with anthropomorphic shape found at Bisauli[1] in Uttar Pradesh has a vague resemblance to the one under discussion but it is not identical though both have been cast and then hammered. One end of the crescentic sleeved axe from Lothal is convex but the other is damaged. The two collars, one on each margin, are also broken. Hence it is not possible to guess the complete shape of the axe, nor can it be said that it was anthropomorphic in form. Hammer marks are very prominently visible on both the sides. As no idea of the working edge can be had, it is not possible to surmise its purpose. Metal-working and ritualistic purpose attributed to it.

The chemical analysis of the Bisauli figure shows 98·77 copper and 0·66 nikel, whereas the Lothal specimen is made up of 96·27 copper, 2·51 lead and only traces of nickel and iron.

B. Spear-head

Thin leaf-shaped blades with a tang and ending in a point are considered as spear-heads, but they are not very much different from the knives which also have an equally thin short blade. Their delicate blades double-up even without pressure for want of a midrib and are therefore less useful than the Sumerian examples. The spear-head of this type must have been hafted into a longitudinally-cut wooden frame which acted as a midrib averting the side play. It is interesting to find that the spear-heads have longer tangs than are necessary for fixing them in the wooden shaft. Some of them have one or two holes in the centre of the tang or blade for fastening them with lashings of leather or with copper wire. The tang is flat and thin with more or less parallel margins. This type of leaf-shaped spear-head does not occur outside the Indian sub-continent. Because of the difficulty of hafting and successfully using these spear-heads as a weapon of defence, Marshall holds that the leaf-shaped spear-heads were trophies captured by the Mohenjo-daro people from their enemies who were of inferior culture.[2] In the first instance we are not sure as to who these inferior people using spear-heads were. Neither the Chalcolithic folk of Ghaneswar nor the Neolithic folk of the Deccan used any spear-head. The copper-hoard of the Gangetic Valley does not contain any leaf-shaped spear-head. Most of the spear-heads found at Lothal are out of shape and highly corroded reducing the core considerably. The spear-head with a recurved point is not found at Lothal whereas it occurs in the Indus valley.[3]

C. Dagger-head

The dagger-heads from Lothal are very small in size varying from 1·2″ to 3·4″ in length. It is doubtful whether they were used as weapons of war at all as they are not strong enough. No midrib is seen in any specimen. Out of 12 daggers found intact in the excavation nine specimens have a thin blade and are tanged. One of them has a folded socket

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[1]*Ancient India* no. 7, p. 24; pl. VI A.

[2]Marshall *op. cit.* II 1931 p. 297.

[3]Mackay *op.cit.* (1943), pl. LXXII-13; Marshall *op. cit.* III 1931, pl. CCXV, 9; Vats *op. cit.* II 1940, pl. CXXIII, *36-37*; CXXV, *65-77*.

while another has a revet-hole near the tang. The former must have been fixed to a pike, but its point is blunted (fig. 109, 1-2).

D. Arrow-heads

The Indus people used an out-moded type of arrow-head without any midrib or substantial tang although their contemporaries in Mesopotamia used a more advanced type of arrow-head. The total number of arrow-heads from Lothal is six. They are thin and flat being cut out from sheets of copper, the length varying from ·75 ins. to 1 ins. They have narrow swallow-tail barbs (fig. 112, 6-9). This type of arrow-head was in use at Telloh[1] and in the 1500-1200 B.C. levels of the Mycanean Tombs.[2]

E. Razor

Three types of razors are noted at Lothal. They have a curved, triangular or L-shaped blade. The total number of razors recovered is five. All of them have invariably a tang for hafting in split-wood, the triangular blades having a rectangular tang. In one case, however, two holes are made in the blade itself for fastening with lashings to a wooden handle (fig. 109). Normally razors are produced by hammering sheet metal before it is trimmed into shape.

Mackay has mentioned two L-shaped blades from Mohenjo-daro.[3] A razor or knife with a curved blade of the Indus type was also found in Hissar III B.

F. Chisels

Chisels are more numerous than any other type of tools at Lothal suggesting thereby the existence of a large number of artisans such as carpenters, boat-builders, bead-makers, seal-engravers, shell-workers, bone-workers etc. who used the tool. These chisels have a double-sloped edge unlike the modern ones which have a single-sloped edge. The process of manufacture appears to be as follows :-

In the first instance copper bars, mostly with a rectangular section and rarely with a round one, were cast in terracotta moulds. They were then hammered and finally the cutting edge was flattened from both the sides, occasionally producing a splay.

Chisels can be classified into three categories. The first category has a square or rectangular section and its margins are parallel (fig. 110, *3*). The second category has a blade with a square or rectangular section and a flat tang (fig. 110, 10). The third category has a round section (fig. 110, 1). The chisels of the first type are found in large numbers and generally have a double-sloped cutting edge. They appear to have been hafted in wooden handles as the butt does not show marks of burring. This type occurs at Tepe Gawra in Stratum II-VIII,[4] in Egypt in the First Dynasty period, in Susa II[5] and at Ur in the pre-sargonic period in the Royal Cemetery.[6] The second type is peculiar to the Indus Valley in that the rectangular body is narrowed to a double-sloped cutting edge. Only one

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[1]In the reserve collections of the Louvre Museum, Paris.

[2]In National Museum of Athens (from the Mycanean Tombs near the Citadel).

[3]Mackay *op. cit.* II, 1938, pl. CXVIII, *7*.

[4]Speiser, *op. cit.* I, 1935 p. 107, 108.

[5]In the reserve collection of the Louvre Museum, Paris.

[6]Woolley *op. cit.* II, 1934 pp. 309.

one specimen from Lothal has a splayed cutting edge and so was the case at Mohenjo-daro. The third type has a double-sloped edge with considerable splay. The length of the chisels in this group varies considerably from 0.6 ins. to 2.2 ins. Marshall[1] calls the smaller ones as 'pick-chisels'. A unique find from Lothal is a small wedge-like chisel with a triangular section (fig. 110, 5). It is almost complete with its butt-end. Another is a very small one with a section, a sharp cutting edge and a tapering butt. Both must have been hafted in wooden handles. Such chisels could be used for cutting blocks of soapstone, steatite and bone.

G. Drill-bit

Drills were used for boring stone beads and shell objects and sometimes for drawing outlines on seals. The high technological development attained by the metal-smiths of Lothal can be seen in making the drills and like-instruments, although they may be lagging behind the Sumerian smiths in making weapons. The drill-bits are of three types. A sharp point projects from the circular flange in the first (fig. 112, 3-4)) resembling those from Egypt and Mesopotamia It is usefull for drilling holes in the buttons of seals and in perforating stone beads. The second type is a hollow flanged-drill (fig. 112, 3-4), in which a nail-pin is found. A similar one with a wire-nail is reported from Telloh[2] also. The third type is unique to Lothal. It has twisted grooves with a chisel-end and works exactly like the modern auger. It must have been fitted into a T-shaped frame to bore holes by rotary movement with downward pressure (pl. CCXLIX B).

H. Awls and Needles

Copper and bronze needles are found in Lothal in considerable numbers. Among them wire-needles are of three types. The first type has a pierced eyelet at the sharper end (fig. 111, *1*) working like an awl. In this case the whole needle did not pass through the fabric. Perhaps a second thread was used from the underside as in a modern sewing machine for stitching tough material like leather and flax. The second type has a thicker end. but no eyelet, (fig. 111, *4*) while the third type has a sharp tip. Needles were made at Lothal from round or flat strips of copper or bronze and the eye was sometimes pierced. The other alternative was to hammer the flattened end all round until the central pieces falls out forming an eyelet. The tool is then filed to give a fine finish. One of the needles from Lothal has a cut point (fig. 111, *3*) which is meant to draw the thread up from the underside as the cobbler does with his needle. Thin wires were used as needles in Giyan, Sialk and Ur. The eyelet was formed by looping the opposite end so perfectly that it looks as if it were pierced.

I. Plainer-bit

A plainer-bit found at Lothal is another interesting tool invented for the carpenter. It is rectangular on plan with a small concavity on either margin. The working edge is sloped from both sides while the butt is thick (fig. 112, *5*). The concavities help to hold the tool in the plainer in proper position. The side-slits noticed in the bit were meant either for fastening with lashings or holding it in a fast grip in the wooden crib.

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[1]Marshall *op. cit.* II, 1931, pp. 501-504.

[2]In the Reserve Collection, Louvre Museum, Paris nos. (14510Tg. 5551).

J. Nails and Rods

Copper nails with a circular section and with or without a head were known at Lothal. The smaller ones were used for pegging and the larger ones for boring. One of them almost resembles the modern wire-nail with a flat head (fig. 113, *1-3*). Six copper rods with a rectangular or round section are found to have longitudinal grooves at regular intervals and might have been used for drawing copper wires (fig. 113, *5*). It is also possible that these grooves were made by chisel in the process of reducing their sections. One of the grooved rods has a pointed end and burred butt resembling a thick nail.

K. Fish-hooks

From the point of view of utility hooks found at Lothal can be grouped under two categories namely, fish-hook and ordinary hooks. The fish-hooks are invariably barbed and the larger shank is either rounded backward at the end to form an eyelet or flattened into a triangular shape for tying a string for suspension (fig. 114, *1-10*). In view of the large size of some of the fish-hooks it can be safely presumed that sea-fishing was well-known to the Lothal fishermen. Similar examples are found at Telloh[1] and in the Pre-sargonid levels of the Royal Cemetery at Ur[2]. Hooks without barbs are bent at one end to form an arc or a right angle (fig. 114, *7-10*).

L. Saw

A partly damaged saw with a curved blade and three teeth intact has been found at Lothal. It is different in size and shape from other saws from the Indus Valley having a straight serrated edge. The Egyptian saw is similar to the one from Mohenjo-daro[3]. The saw from Lothal must have been used for cutting grooves in ivory and shell objects of circular shape e.g. gamesmen, rings etc. or for trephining.

5. PERSONAL ORNAMENTS

The coppersmiths of Lothal paid great attention to the manufacture of personal ornaments in copper and bronze which account for nearly 25 percent of the total number of objects of copper and copper-alloys found here. Occasionally they used 'real bronze' for making bangles etc. The ornaments are broadly divided into bangles, rings, pendants and beads.

A. Bangle

Lothal has yielded four types of bangles. The first type is made of flat strips of copper and the second with solid round bars. The third type is produced by folding metal into 'u' shape and was perhaps filled in with resin to avoid injury to the wrist from the open margins. The fourth type was cast in a mould and has a corrugated edge. The ends of the first three types of bangles are generally open, but in a few cases they overlap. There is no

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[1]In the reserve collection of the Louvre Museum, Paris.

[2]Woolley *op. cit.* II, 1934 pl. 230.

[3]Marshall *op. cit.* 1931, p. 501-502.

example of forging. The internal diameter of the bangles varies from 1·5″ to 2·6″ ins, the average besig 2 ins.

B. Ring

Two types of rings namely coiled and plain ones with a rectangular or round section can be distinguished. The Lothal folk had a special favour for spiral rings, some of which have as many as seven spirals. They are further decorated by one or two-discs coiled in the form of a labyrinth (pl. CCXLII B *1-7*; fig. 116). The ring was formed first by coiling the central one- third of the wire while the remaining one-third on either side was formed into labyrinths. Such rings are considered very sacred and worn in marriage ceremonies on the toes by the bride and on fingers by the bride and bridegroom even now in India.

C. Ear-ornament

Ear-rings and pendants of copper resemble those in gold and steatite. Two circular discs with a convex surface were joined together to form rings, ear ornaments (fig. 115, *6-13*). One or two holes were also made in the centre for suspension with a copper wire or for wiring with a stud. Even to this day similar types of ear-rings and pendants made of silver and gold are used by the women in Gujarat. Copper wires formed into rings must have also been used by the Lothal folk as ear-ornaments.

D. Beads

As many as 95 beads of copper and bronze are found at Lothal. They are of various shapes and sizes. The spacer beads have two to five holes. The only facetted bead found at Lothal has its parallel in the pre-Sargonid period in the Royal Cemetery at Ur. The description of the beads is given in Chapter XXI (below p. 580).

6. ANIMAL FIGURINES

The high artistic sense of the coppersmiths is apparent from the miniature cast models found in the excavations. One of them is of a crouchant bull used as an amulet. Two specimens of dog and one each of a bird, a hare, a cock and a leopard animal are found. The only well-preserved figures are of two dogs. Other figures are corroded and have lost the sharpness of details. As already remarked earlier, closed moulds of more than one piece must have been used for this purpose. From what little details of the eyes are available in the case of the dog and hare, it is apparent that the moulds were carefully worked.

A. Bull

The bull with its body in profile and head in front-view is shown in a crouchant position with its legs double-folded and head raised high. The horns are clearly visible but the ears are damaged. The mouth of the animal is indicated by a slit. Owing to corrosion the eyes are not clearly visible but they were inlaid. The eye-brows are however clear. That the figure was used as an amulet is evident from the longitudinal perforation from end to end. Similar figures of bull are found in silver, lapis lazuli and copper in the Royal Cemetery at Ur. A copper bull-amulet is reported from the First Dynastic levels of Al'Ubaid and in Susa Dd.

B. Hare

A beautiful figure of a hare with long prick-ears and short muzzle is found damaged, but enough still remains to identify the animal. No example of a hare in copper is ever found in the Indus Valley or the Middle East.

C. Dog

One of the miniature figures of dog in copper from Lothal is shown looking sideways with its head raised slightly above the body level. It has a short, round body and short legs which, though not separated fully, are fairly clear. The lop-ears and short raised tail are also shown artistically (fig. 117, 3 pl. CCXLIV A). The figure is very realistic and even minute details are brought out. The artist has maintained the correct proportions. Another figure is larger in size and the animal looks front and the body is of stout build (fig. 117, 4; pl. CCXLIV B). Both come from Period A.

D. Bird

A copper figure of a bird-on-rod looks like a swan with its erect head. The projections on either side of the body may indicate wings. This figure has close resemblance to the terracotta figures of birds from Lothal (pl. CCXLVA). The traces of shaft are seen at the bottom as in the case of the bird-headed pins from Alisar, Tepe Hissar etc. Recently a similar figurine of a bird has been reported by Dr. Globb in his excavations at Barbar[1] but it is much bigger in size than the Lothal specimen.

E. Fowl

Inspite of corrosion, a copper figure appears to be a fowl from its short pointed beak, the crown over the head and the prominent plumes (pl. CCXLB).

F. Leopard

Another interesting figure is what looks like a squatting wild beast looking sideways. It may represent a leopard (pl. CCXLVI A).

7. MISCELLANEOUS

A. Chain

Chain-links, of which examples are found at Mohenjo-daro and Harappa, occur at Lothal also. One of them has four links joined together by beating one into the other after heating. The ends are slightly open as in the case of the chain-links from Mohenjo-daro.[1] Similar chain-link[2] are noticed in Sialk II also.[3]

[1]P. V. Globb in *Kuml* 1954 p. 151, fig. 7.
[2]Marshall *op. cit.* III 1931 27-28, pl. CXLIII.
[3]Ghirshman *Iran* Paris, 1961, fig. 31.

B. Spoon

A specimen of a spoon, the receptacle and handle of which are formed by folding a flat strip of copper into the required shape, has been found at Lothal (fig. 118, *1*). Other fragments of similar shape also appear to be parts of spoons.

C. Jar

A big carinated copper jar formed by revetting sheets of metal in two parts (pl. CCXLVIII B; fiig. 119) was found in the warehouse block. It resembles jars found at Harappa and Mohenjo-daro.

D. Mirror

The bronze mirror from Lothal is ovoid on plan. A similar mirror was found at Harappa[1] also. In the case of Lothal specimen the surface is slightly concave and the handle is broken. (pl. CCXLVI A; fig. 118, *2*).

Fig. 106; Pl. CCXXXV A

1. Long narrow blade-axe; rectangular section; splayed at the edge from one side. Tapering toward[1] the butt; probably hafted in a wooden handle. From phase IV, Period A (No. 11960)[2].

2. Long narrow blade-axe; rectangular section; sloping splayed cutting edge; damaged. From phase IV, Period A (No. 10595).

3. Long narrow blade-axe; parallel margins; thin cutting edge; butt broken; From phase IV, Period A (No. 9046).

3. Long narrow blade-axe; parallel margins; thin cutting edge; butt broken; From phase IV, Period A (No. 9046).

4. Long narrow blade-axe: rectangular section; thin cutting edge: broken butt; Unstratified. From Period A (No. 9952).

5. Transverse axe; triangular section; cutting edge sloped from both sides and splayed. Thick rounded butt; working edge damaged. From phase II, Period A (No. 5223).

6. Transverse axe; rectangular section: broad cutting edge; sloped steeply from one side and slightly from the other; thick converging butt; From phase III, Period A.

7. Transverse axe; rectangular section; splayed cutting edge sloped from both sides; concave margins; broken butt; surface rough indicating hammering. From pAase V, Period B. (No. 3091).

Fig. 107; Pl. CCXXXV B

1. Axe with a broad short blade; rectangular section; double-sloped and splayed cutting edge; margins parallel; corners and butt rounded. Unstratified. Period B. (No. 12378).

2. Axe with a broad short blade; lenticular section; broad splayed cutting edge sloped from both sides; slightly concave margins. From phase IV, Period A. (No. 5957).

Pl. CCXXXVI A

3. Axe or copper-working tool with two unsymmetrical sleeves on the margin; one edge blunt and crescentic in shape; opposite edge and sleeves damaged; Deep hammer marks all over the surface; From phase IV, Period A. (No. 10918). Vaguely resembles an axe from Shahjahanpur.

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[3]Vats *op. cit.* II, 1940 P. CXXIV, 29

[2]Marshall *op. cit.* III 1931 pl. CXXXVIII, *1*. Mackay, *op. cit.* II 1938 pl. CXX, *30*.

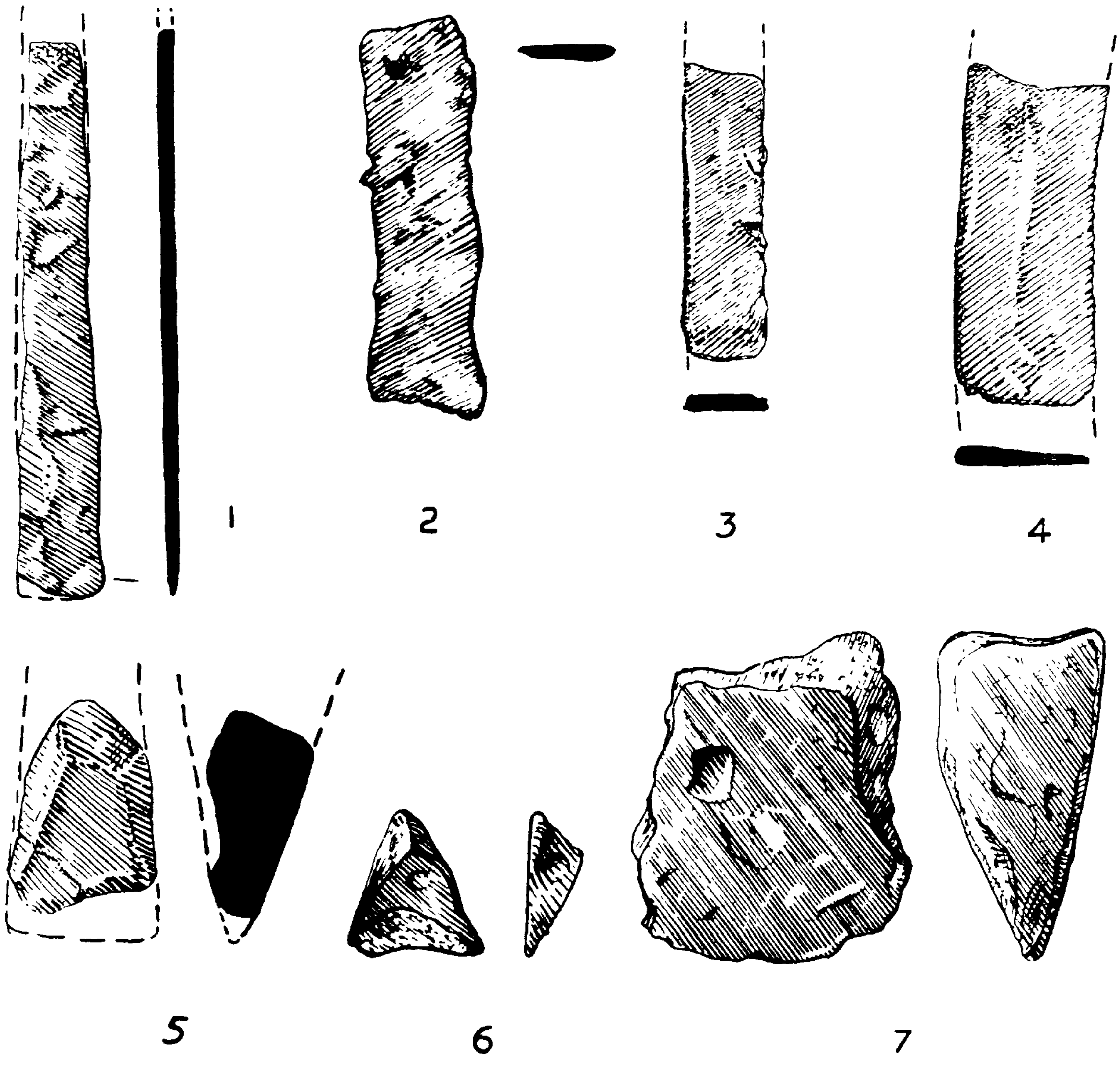

FIG. 106. *Copper axes—1-4 narrow blade axes; 5-7 transverse axes; scale 1/1*

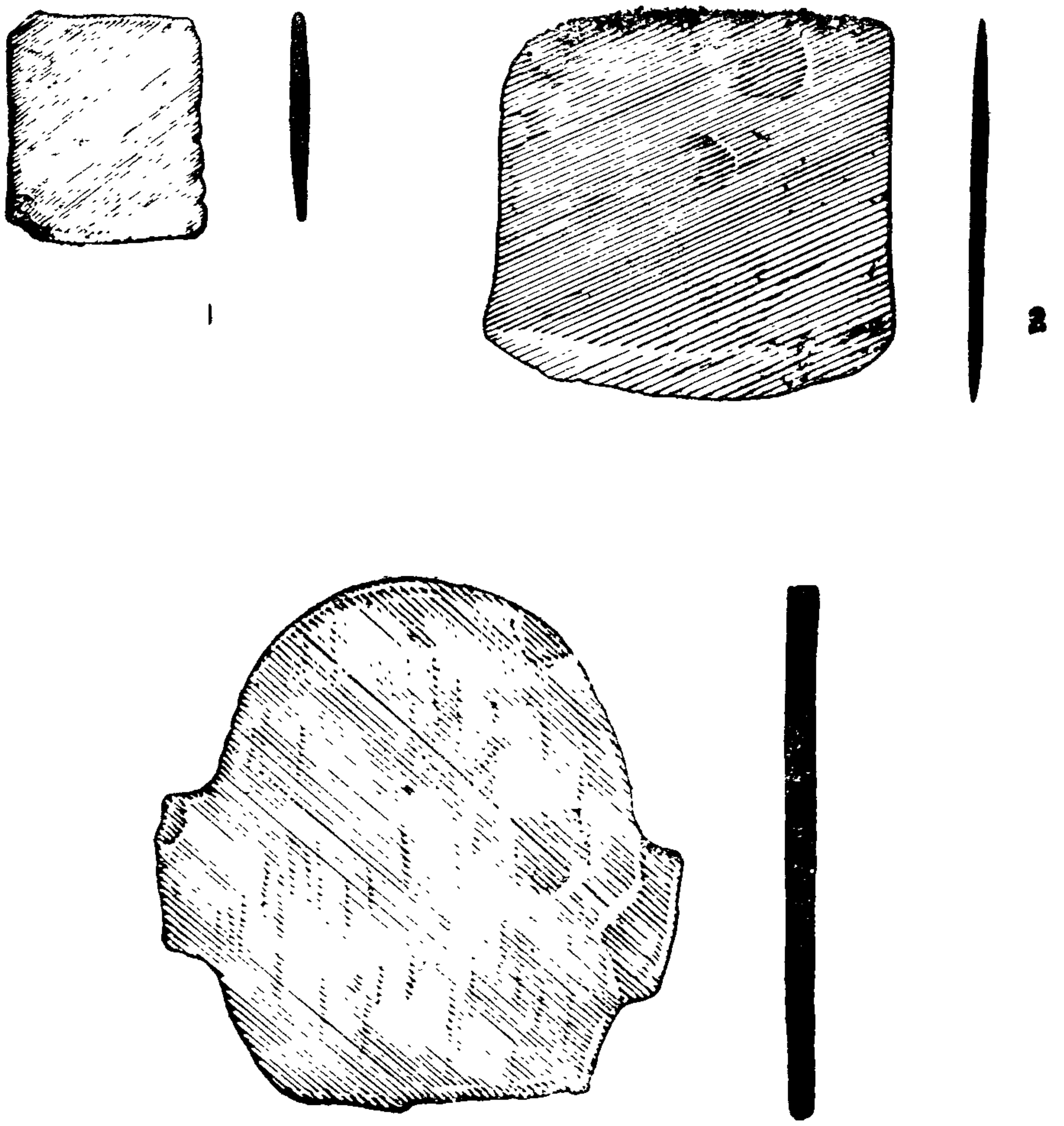

FIG. 107. *Copper celts (1-2) and sleeved axe (3) Scale ½*

Fig. 108; Pl. CCXXXVI B

1. Long leaf-shaped spearhead with pointed margin; margins of a thin flat blade converging to a point; thin flat tang. From phase II, Period A. (No. 6646).

2. Small leaf-shaped spearhead; thin flat blade and tang. From phase III, Period A. (No. 7808).

3. Small leaf-ehaped spearhead; thin flat blade; Damaged; From phase IV, Period A. (No. 2645).

4. Lead-shaped squattish spearhead; thin flat blade; perforated in the centre for securing in the spilt wooden shaft with lashing; tang short and broad; From phase IV, Period A. (No. 5470).

Fig. 109; Pl. CCXXXVII A

1. Triangular daggerhead; thin; narrow blade with rectangular section. tang broken. From phase IV, Period A. (No. 9973).

2. Leaf-shaped daggerhead; thin blade; tang broken. From phase IV, Period A. (No. 10214).

3. Long narrow dagger with a folded socket; margins tapering to a point. Perhaps hafted to a pike. From phase II, Period A. (No. 1788).

Pl. CCXXXVII B

4. Incurved blade; sharp cutting edge: From phase IV, Period A. (No. 8480).

5. Lunate-shaped blade with a straight cutting edge; no tang. From phase IV. Period A. (No. 5018).

6. Double-curved blade with a blunted working edge; tang visible. From phase III, Period A. (No. 635).

7. Lunate-shaped blade with a sharp cutting edge; convex margin; no tang. From phase V, Period B. (No. 10887).

8. Lunate-shaped blade; damaged. From phase III, Period A. (No. 5862).

9. Long triangular blade with a convex cutting edge; tang for hafting. From phase IV, Period A. (No. 794).

10. Long curved-blade with a concave cutting edge; oblique tang; perhaps used as a sickle; tip broken. From phase IV, Period A. (No. 3270).

Fig. 110; pl. CCXXXVIII

1. Chisel made from a rod of circular section; tapering working edge; slope from both sides and slightly splayed; butt damaged; From phase III, Period A. (No. 4619).

2. Chisel made from a bar with ovoid section; working edge sloped from both sides and margins are rounded; pointed butt. From phase II, Period A. (No. 294).

3. Chisel made from a bar with a rectangular section; tang with a circular section; cutting edge sloped from both sides; tang twisted in use. From phase III, Period A. (No. 8252).

4. Chisel made from a rod of more or less round section; cutting edge sloped from both sides and slightly splayed; butt broken. From phase IV, Period A. (No. 4692).

5. Chisel made from a small bar with round section; cutting edge sloped from both sides; tapering butt for hafting. From phase II, Period A (No. 14016). Marshall calls it as pick-chisel.

6. Chisel made from a bar with a rectangular section; cutting edge sloped from both sides and splayed considerably. From phase II, Period A. (No. 3063).

7. Chisel made from a bar with a square section; cutting edge sloped from both sides and slightly splayed; damaged. From phase IV, Period A. (No. 5819).

8. Chisel made from a bar with an ovoid section; oblique cutting edge sloped from both sides; tapering butt for hafting; probably used for chiseling as well as engraving. From phase IV, Period A. (No. 4481).

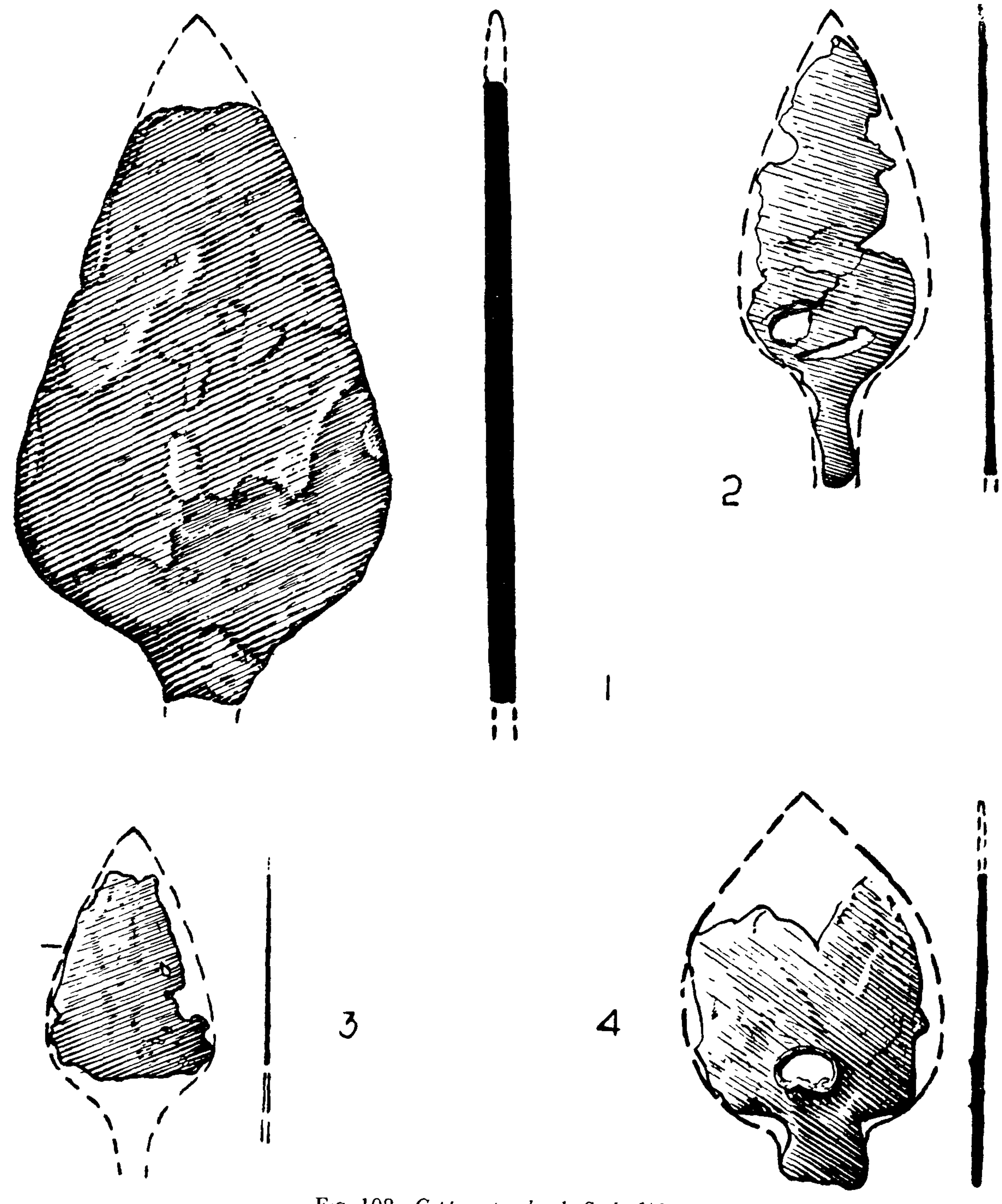

FIG. 108. *Copper spearheads Scale 1/1*

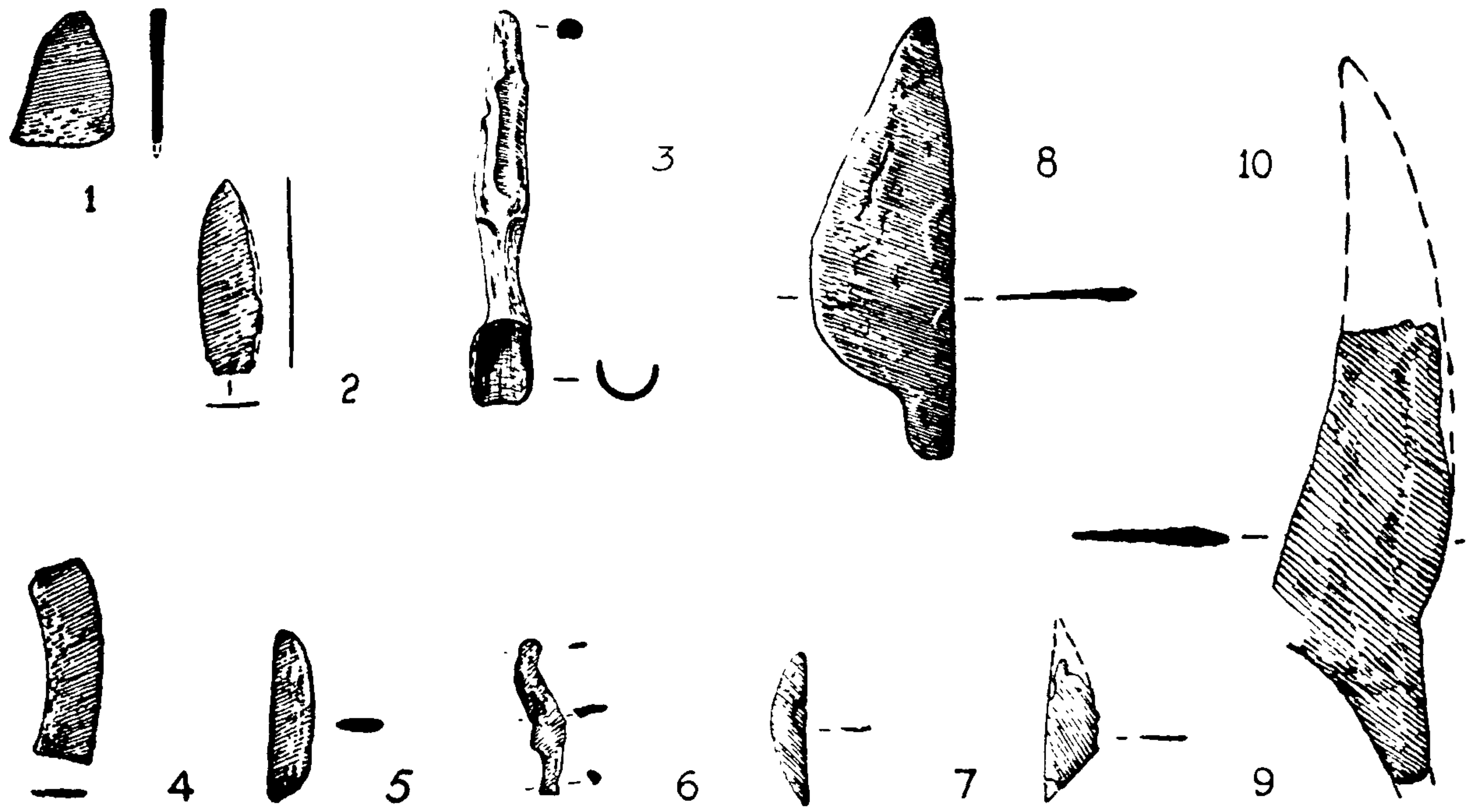

FIG. 109. *Copper daggerheads (1-3) aud blades (4-10) Scale ½*

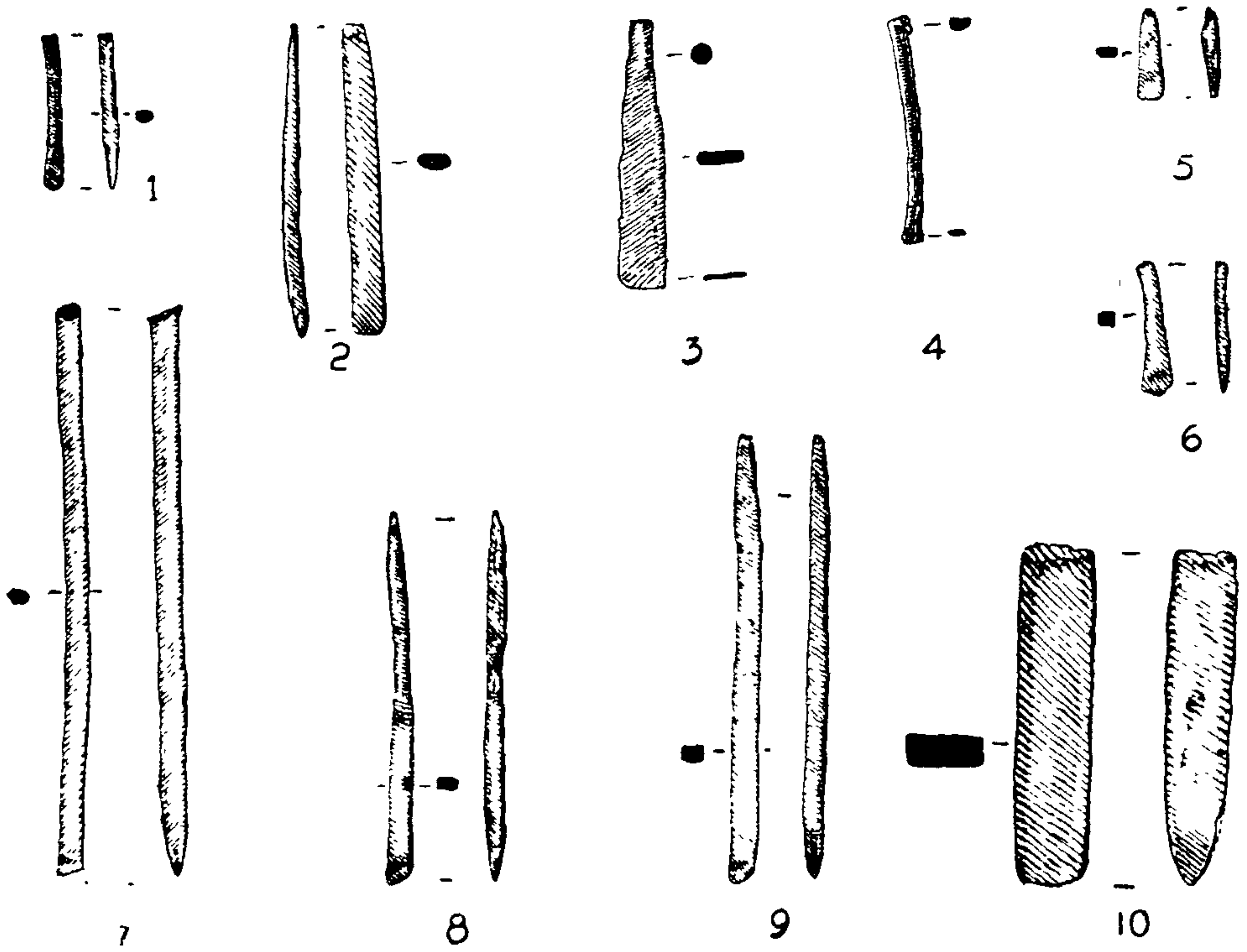

FIG. 110. *Copper chisels Scale ½*

9. Chisel made from a bar with a rectangular section; cutting edge sloped from both sides; tapering butt for hafting. From phase III, Period. (No. 8110).

10. Chisel made from a chick bar with a square section; cutting edge sloped from both sides and splayed, butt burred due to hammering. From phase IV, Period A. (No. 12538).

Needles Fig. 111; pl. CCXXXVII C

1. Needle; made from a wire with round section; eyelet at the piercing end partly damaged. From phase III, Period A. (No. 4686)

2. Needle; round section; eyelet at the thicker end faintly visible; damaged. From phase I, Period A. (No. 983).

3. Needle; ovoid section; one end pointed and the other flattened from both sides; splayed in a disc form and notched at the point of splay; resembles cobbler's needle which draws up the thread from the underside: also used for removing ear-wax. From phase IV, Period A. (No. 2613).

4. Needle made from a thin wire with round section; twisted; From phase III, Period A. (No. 14302).

5. Needle made from a thin flat wire with a rectangular section; Ovoid eyelet at the piercing point. From phase III, Period A. (No. 3226).

Awls and pins (pl. CCXXXIX A)

6. Awl; circular section and tapering point. Damaged; From phase II, Period A. (No. 12876).

7. Awl; round section; slightly beaked point; Damaged. From phase II, Period A. (No. 5819).

8. Awl; round section and slightly curved point. From phase IV, Period A. (No. 12554).

9. Awl; round section; gradually tapering to a very sharp point. From phase V, Period B. (No. 14195).

10. Awl; round section; damaged towards the butt end. From phase I, Period A. (No. 13257).

11. Awl; round section; both ends flattened from both sides, one and slightly splayed and the other sharp; Perhaps used as an awl. From phase III, Period A. (No 5904).

Fig. 112; pl. CCXXXIX B

1. Auger-bit; square section with ridged margins produced by grooves twisted spirally. A unique specimen. From phase III, Period A. (No. 7136). Not found in the Indus Valley.

2. Hollow-drill; cylindrical and hollow in section with a wire nail; sharp point of the nail projecting outside. Resembles tubular drills of Chanhu-daro.[1] From phase III, Period A. (No. 5043).

3. Flanged drill; round in section; flanged above the pointed end; used for boring holes in beads. From phase IV, Period A. (No. 12699).

4. Flanged drill; round section; flange above the pointed end; From phase IV, Period A. (No. 12356).

Pl. CCXL A

5. Plainer-bit with slightly concave margins; rectangular section; double-sloped working edge; thick flat butt andc oncave margin for fixing the blade in the plainer. Unique specimen. From phase IV, Period A. (No. 10842).

Pl. CCXL B

6. Barbed arrow-head; made from sheet-metal; damaged. From phase III, Period A. (No. 12327).

7. Barbed arrow-head; made from sheet-metal; triangular; slightly damaged. From phase II, Period A. (No. 1231).

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[1]Mackay *op. cit.* (1943), pl. LXXII.

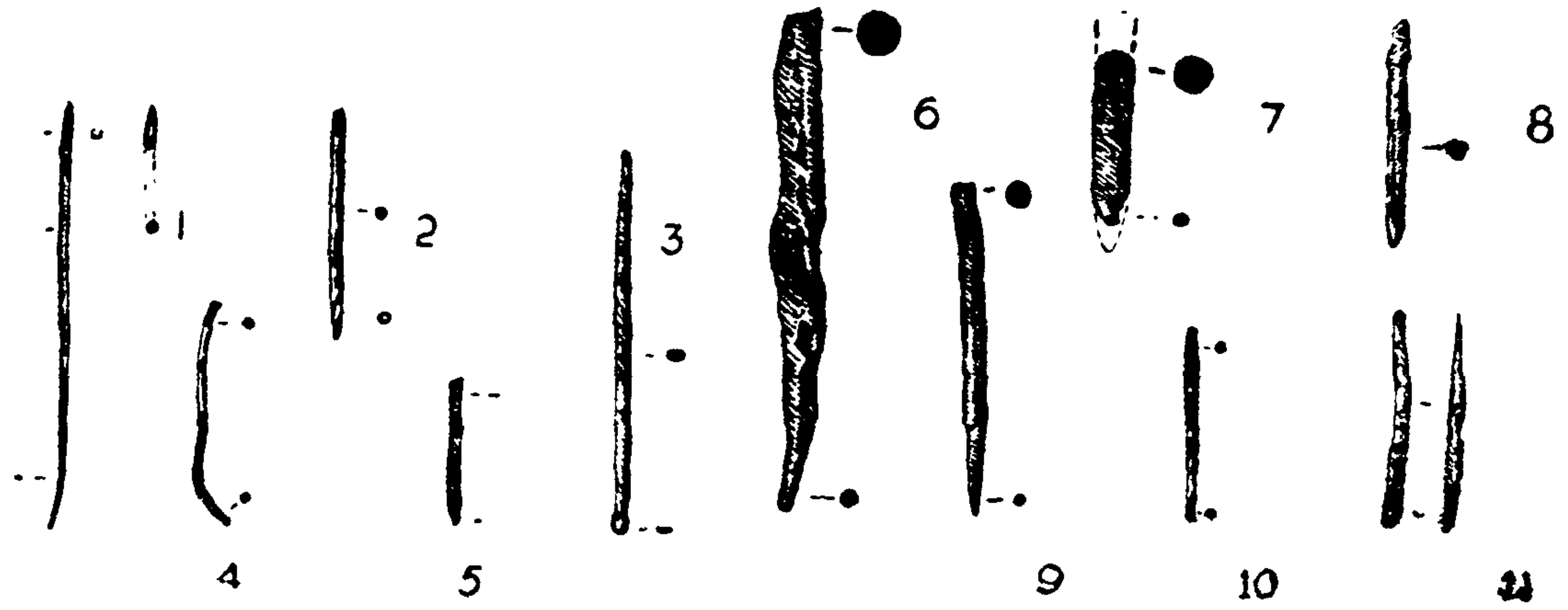


FIG. 111. *Copper needles (1-5), awls (6-11) Scale ½*

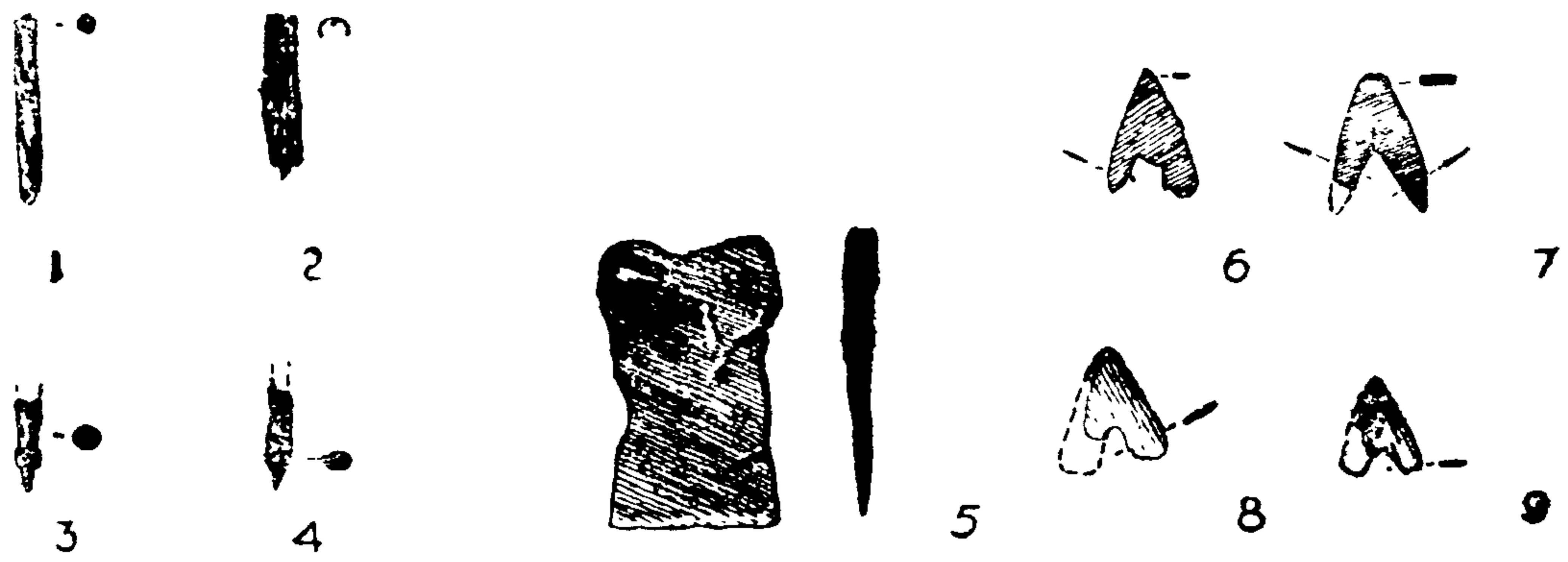


FIG. 112. *Broze auger and drill-bits (1-4), copper plainer bit (5) and arrow-heads (6-9) Scale ½*

8. Barbed arrow-head; made from sheet-metal; triangular; damaged. From phase II, Period A. (No. 6066).

9. Barbed arrow-head; made from sheet-metal; triangular; damaged. From phase II, Period A. (No. 4794).

Fig 113; pl. CCXL C

1. Nail; round section; grooved longitudinally; flat circular butt; blunted end; probably used as an awl for boring revet holes on metal sheets, daggers etc. From phase III, Period A. (No. 14938).

2. Nail; round section; pointed end; circular top; Used for pegging and joining wood. From phase III, Period A. (No. 10126).

3. Nail; square section; point slightly damaged; From phase V, Period B. (No. 14894).

4. Bolt; round section; flat circular head; From phase III, Period A. (No. 8454).

5. Rod with grooved round section. Four deep grooves cut longitudinally; from Bead factory; phase IV, unstratified; Period A. (No. 13886).

Fig. 114; pl. CCXLI A

1. Fish-hook; ovoid section; eye formed by looping up the end of the upper shank, and barb trimmed up in the lower shank. From phase IV, Period A. (No. 1932).

2. Fish-hook; round section; other particulars as above; Unstratified; Period. (No. 6042).

3. Fish-hook; flat top; barb broken. From phase IV; Period A. (No. 13102).

4. Fish-hook; rectangular section; rod with a barb; but not bent as in the above cases. From phase III, Period A. (No. 14683).

5. Fish-hook; round section; Damaged; From phase IV, Period A. (No. 1179).

6. Hook; round section; loop and barb damaged. From phase IV; Period A. (No. 8363).

7. Hook; round section; barb, loop and shank damaged; From phase V, Period B. (No. 12412).

8. Hook; rectangular section; rod bent into L-shape. From phase IV, Period A. (No. 5578).

9. Hook; round section; U-shaped wire corroded. From phase II, Period A. (No. 11943).

10. Hook; round section; wire bent into L-shape. From phase IV, Period A. (No. 13140).

11. Hook; round section from Phase III, Period A.

Fig. 115; pl. CCXLI B

1. Bangle; round section; open ends. From phase I, Period A. (No. 1344).

2. Bangle; round section; overlapping ends; corroded; From phase IV, Period B. (No. 10627).

3. Bangle; plano-convex section; indented exterior; open ends. A unique specimen. From phase III, Period A. (No. 1145).

4. Bangle; round section; overlapping ends. From phase IV; Period A. (No. 12143).

5. Bangle; hollow circular section; metal strip folded into hollow bangle and filled with resin. From phase IV, Period A. (No. 3637).

Pl. CCXLI C

12. Saw; incurved blade with a rectangular section; Three teeth intact; one end straight for hafting. From phase II; Period A. (No. 49).

Fig. 115, *6-14* Pl. CCXLII A

6. Ear-ornament; convex disc; perforated; the second convex disc missing; From phase IV, Period A. (No. 5628).

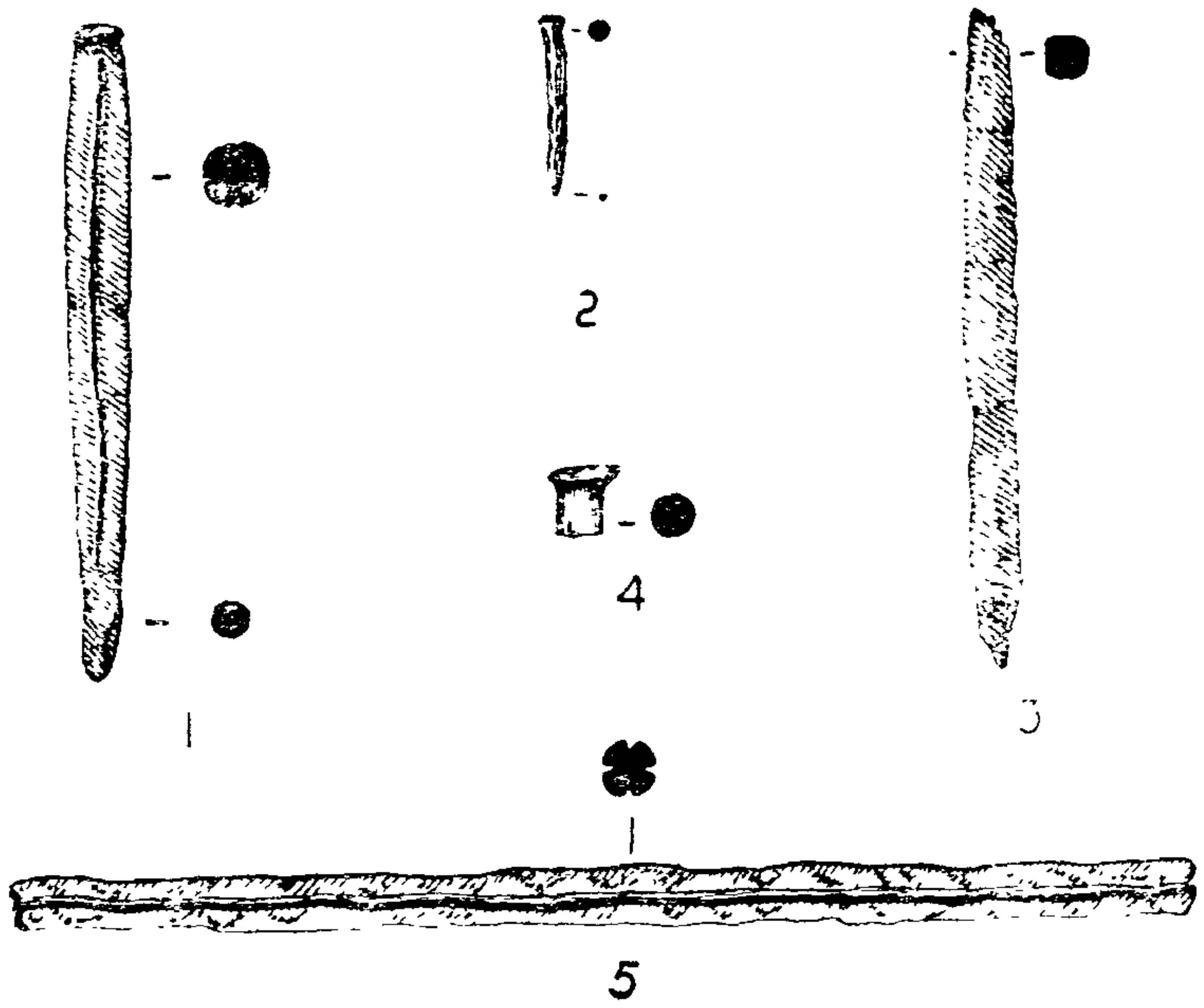


FIG. 113. *Copper nails (1-3), bolt (4) rod (5) Scale ½*

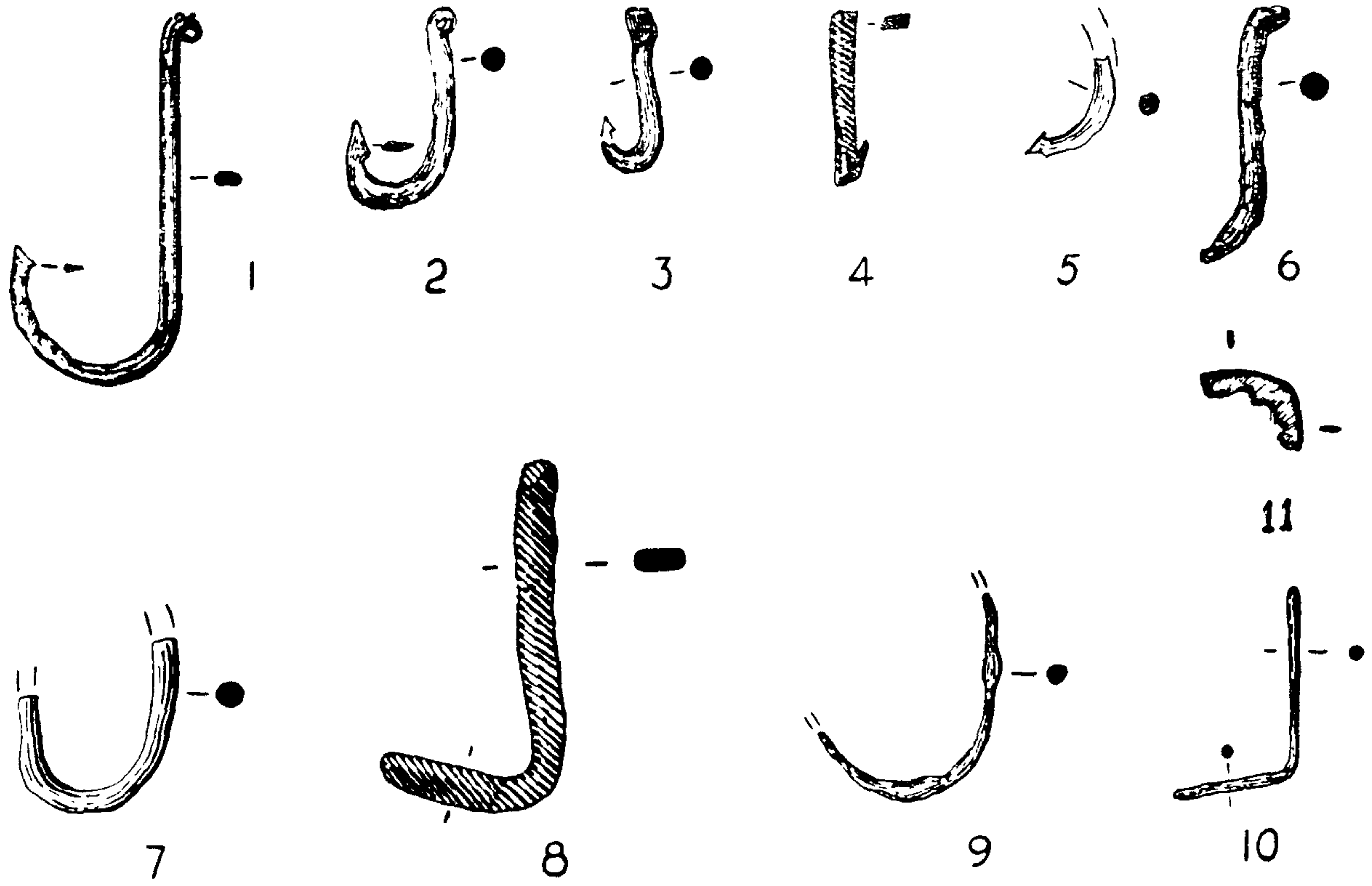


FIG. 114. *Fish-hooks (1-10) and curved saw (11) Scale ½*

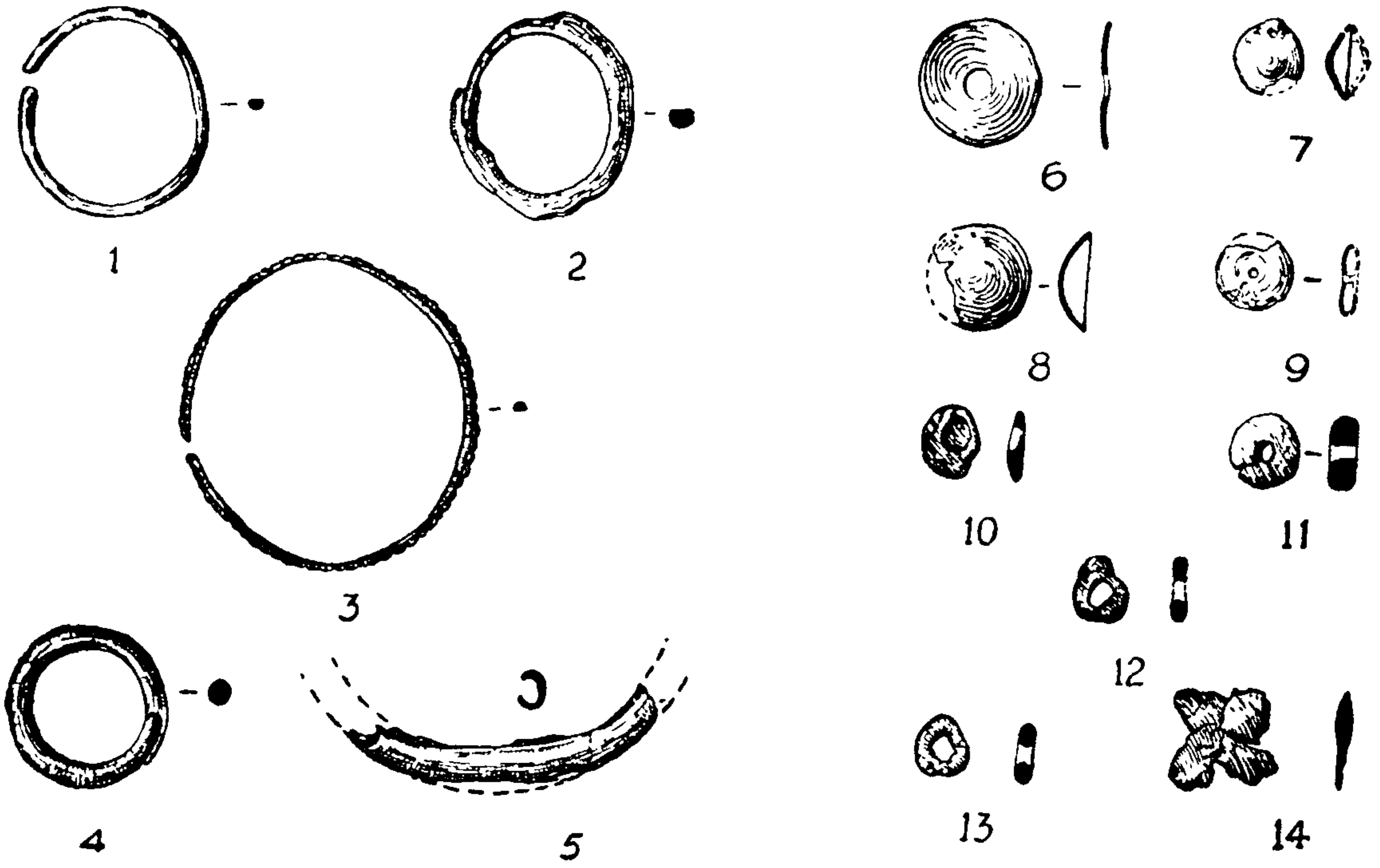


FIG. 115. *Copper and bronze bangles (1-5); Ear-ornaments (6-13) and object of floral pattern (14) Scale ½*

7. Ear-ornament; convex disc with two perforations on the margin; other half missing; From phase II, Period A. (No. 5311).

8. Ear-ornament; convex disc. From phase III, Period A. (No. 6225).

9. Ear-ornament; convex disc; perforated; other half missing. From phase III, Period A. (No. 2911).

10. Ear-stud; irregular section; hollow centre produced by coiling a wire over a metal sheet and perforated. From phase II, Period A. (No. 1613).

11. Ear-stud; rectangular section; prepared from a thick flat strip. From phase I, Period A. (No. 360).

12. Ear-ring; rectangular section; made from a flat strip, ends joined by touching. From phase II, Period A. (No. 12019).

13. Ear-ring; round section; ends joined by touching; Found in grave 6 near the ear of skeleton No 9. From phase III, Period A. (No. 14855).

14. Ornament with floral design produced by joining four pieces of sheet; From phase III, Period A. (No. 551).

Fig. 116; pl. CCXLIIB

1. Ring; made from coiled wire; The central part of a long wire is coiled into three spirals to form the ring; the left overs on either side are coiled in opposite directions into concentric circles. Ends are perfectly set within, side rings look like wings of a bird. From phase IV, Period A. (No. 11858).

5. Ring; coiled; in two spirals; made from half-round flat strip. From phase IV, Period A. (No 2633).

6. Ring; coiled in three spirals. From phase V, Period B. (No. 14854).

7. Ring; coiled in three spirals; made from flat strip. From phase III, Period A. (No. 3233).

8. Ring; made from a round rod; overlapping ends. From phase II, Period A. (No. 838).

9. Ring; made from half-round strip. From phase IV, Period A. (No. 7904).

10. Ring; made from a round wire; ends joined by touching. From phase II, Period A. (No. 872).

11. Ring; formed from a flat strip of rectangular section; overlapping ends. Damaged; From phase III, Period A. (No. 4744).

12. Ring; made from a flat strip; overlapping ends From phase II, Period A. (No. 2616).

Pl. CCXLIII A

Bull, crouchant body in profile in front view. The folded legs, raised head and horns are clearly visible. Slit mouth and eye brows faintly seen. Axial hole indicates that the figure was used as an amulet. From phase III, Period A. (No. 297). Fig 117, *1*. Similar figurines of bull found in silver, lapis lazuli and copper at Ur. The copper figure comes from the First Dynastic levels.

Pl. CCXLIII B

2. Hare; long pricked ears; short mouth; damaged but enough remains to identify the animal; head in front view and the slim body in profile. No example of a hare in copper is ever found in the Indus Valley or the Middle East. From phase II, Period A. (No. 6044). Fig. 117, *2*.

Pl. CCXLIV A

3. Miniature dog; looking sideways with its head raised slightly above the body level and short legs clearly indicated; top ears and short raised tail. No such example of a dog has come to notice from the Indus Valley or elsewhere. Unstratified. Period A. (No. 5038). Fig. 117, *3*.

Pl. CCXLIV B

4. Dog; slightly raised head: lop ears, thick neck; fairly long legs and erect tail; looking front. From period A. (No. 15387). Fig. 117, *4*.

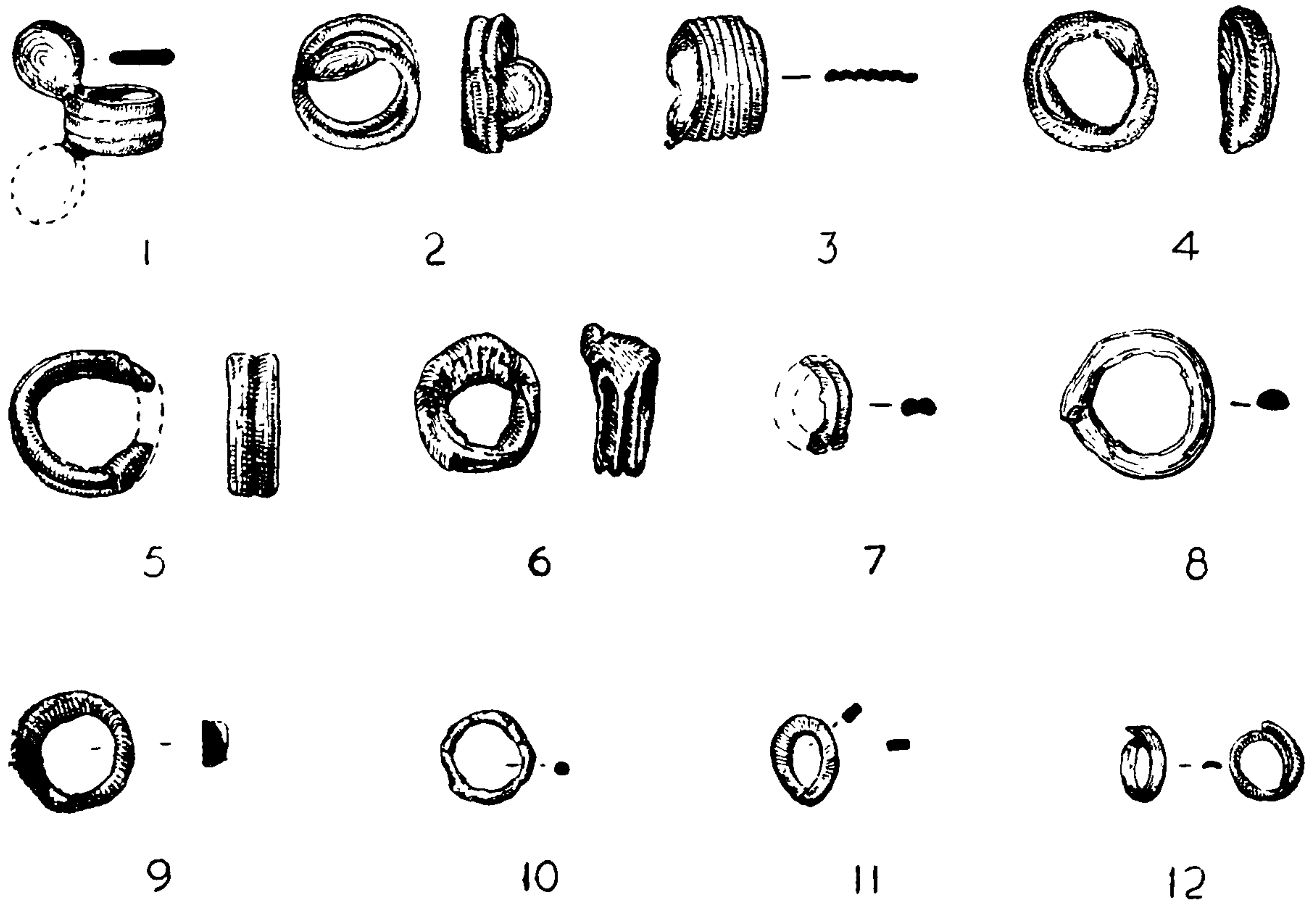


FIG. 116. *Copper-ring with spirals, Scale 1/1*

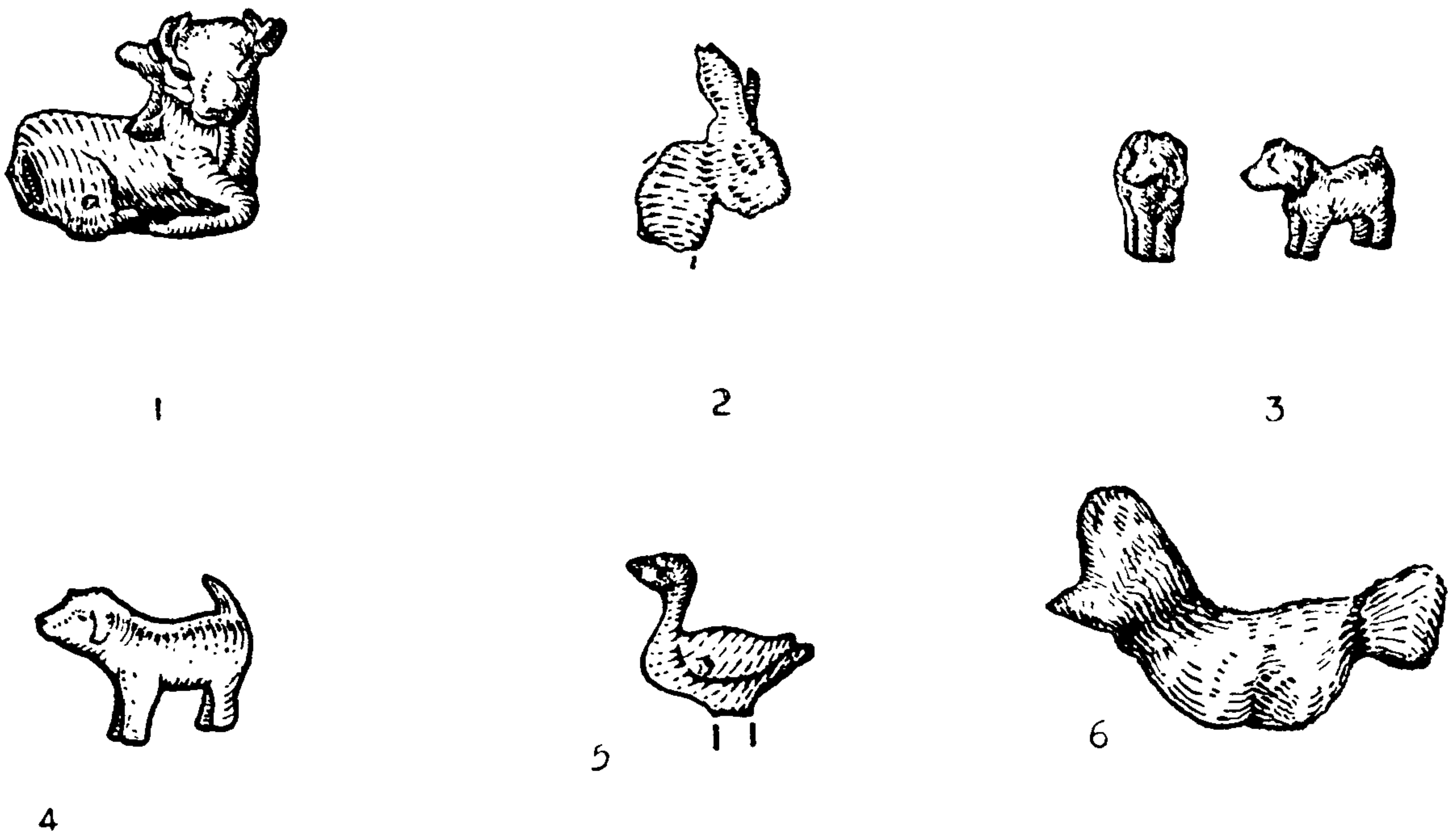


FIG 117. *Copper animal figures etc., 1, Bull; 2, Hare; 3, Miniature dog, 4 dog; 5, bird and 6, cock, Scale 1/1*

Pl. CCXLV A

Bird: raised head, wings indicated by a slight projection on either side. Traces of the shaft visible. A bird-head pin. From phase III, Period A. (No. 8248), Fig. 117, *5*. Bird with slightly open wings occurs in terracotta. A bird-on-rod of similar type is found in the Bahrain Island (below p. 52).

Pl. CCXLV B

5. Cock; with short pointed beak; crown over the head, prominent plumes. Highly corroded. From phase V, Period B. (No. 13186). Fig. 117, *6*.

Pl. CCXLVI A

Mirror, bronze, apple green, ovoid and slightly concave surface; handle broken. Unstratified. Period A. (No. 15030). Fig. 118, *3*. Similar ones are found in Sialk and Harappa.

Pl. CCXLVI B

1. Spoon, made from a flat sheet of a metal, half of which is curved up to form the receptable and the other half beaten into handle. From phase IV, Period A. (No. 4138). Fig. 118. *1*.
2. Chain, with two links intact and the other two broken. From phase III, Period A. (No. 4190). Fig. 118, *2*.
3. Chain, with two links; damaged; From phase IV. Period A.

Pl. CCXLVII A

Bun-ingot, semispherical in shape. From phase III. Period A. (No. 14535), fig. 117, *4*.

Pl. CCXLVII B

Bun ingot from Susa. Top view.

Pl. CCXLVIII A

Lothal ingot; side view.

Fig. 119; pl. CCXLVIII B

A larger copper jar with flaring rim, concave neck, sharp carinated shoulder, overlapping margins and round revetted base; Circular revets seen at close intervals. It appears that the base was first prepared and then the shoulder was joined by hammering and revetment. From the warehouse area. From phase IV, Period A.

Pl. CCXLIX A

Copper sheet from phase IV, Period A. P. 522.

Pl. CCXLIX B

Use of bronze angur (drill) bit in a bow drill.

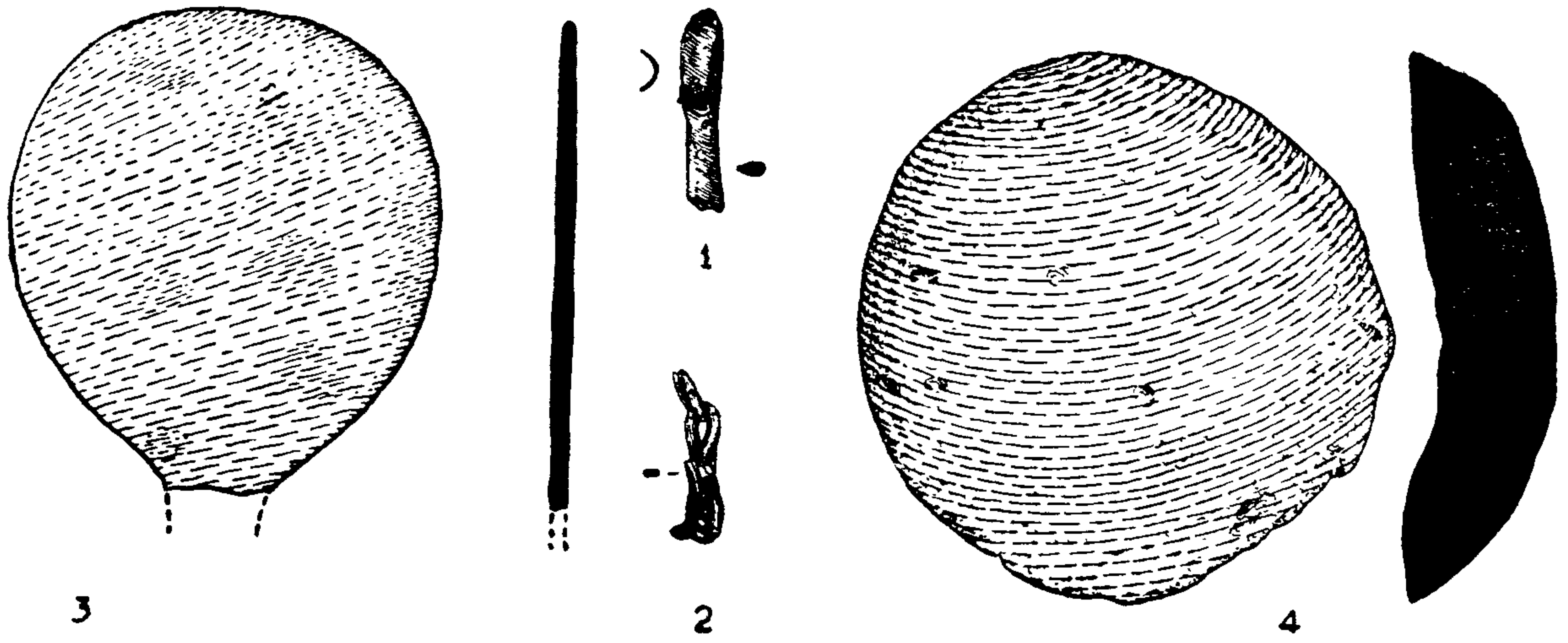


FIG. 118. *Copper spoon(1), Copper chain (2), Copper mirror (3), Copper ingot (4), Scale ½*

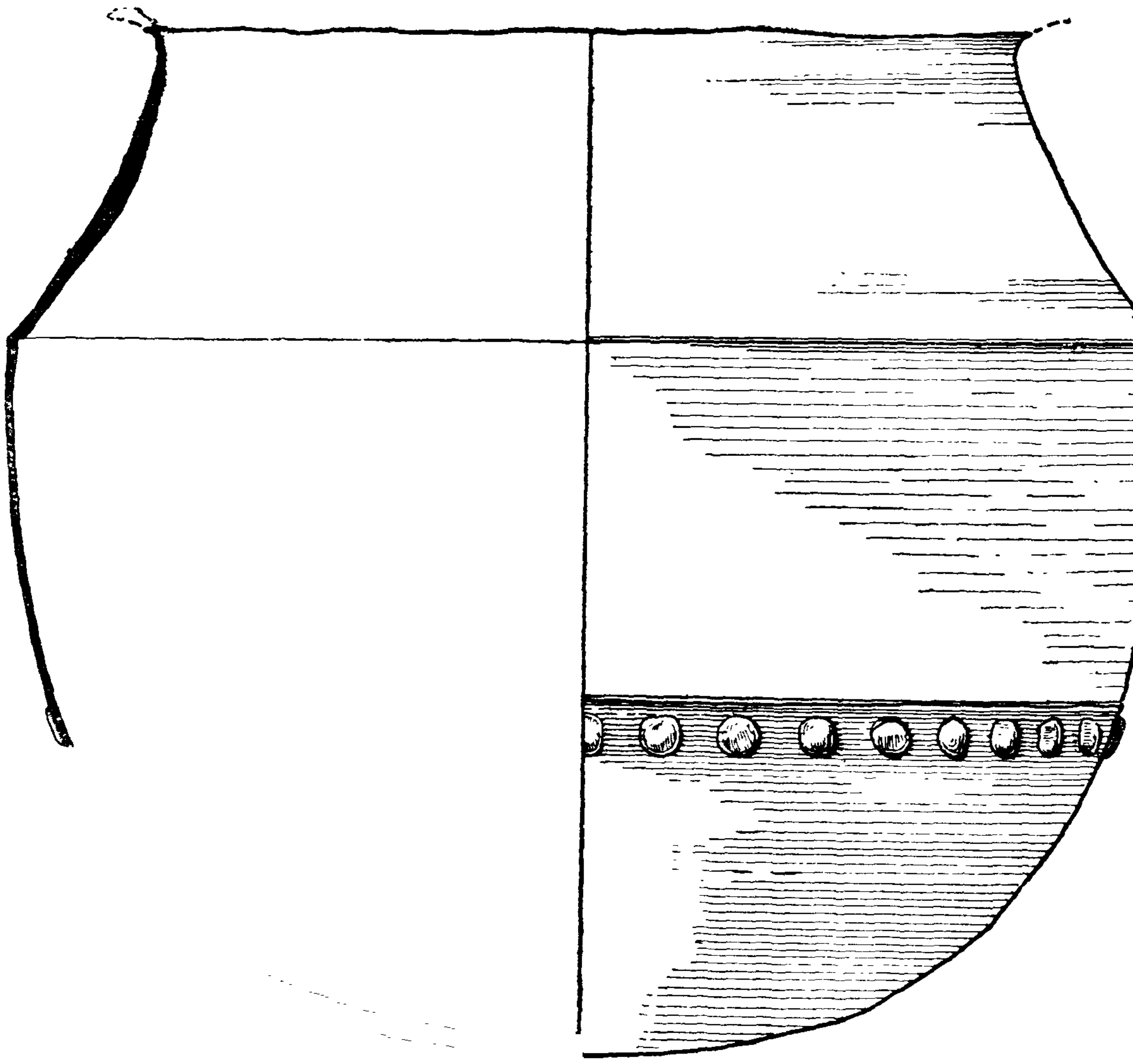


FIG. 119. *Copper jar Scale ½*

CHAPTER XX

STONE OBJECTS

1. INTRODUCTION

Lothal is situated in the coastal belt of the Kathiawar peninsula where thick deposits of alluvium and blackish clay form the natural soil. Stone is not to be seen on the surface for nearly 50 miles around Lothal until one reaches the Ranpur hills where weathered trap is available. Hence stone of good quality had to be imported in proto-historic times from long distances over land and sea depending on the quality of the material needed. Sandstone which is available in plenty near Dharangadhra appears to have been made use of for making querns, mullers, pounders, whetstones, hammerstones, balls, burnishers and maceheads. Limestone and sandstone were used for anchors. Fine-grained chert needed for making blades, weights and engravers must have been imported from Sukkur-Rohri region in Sind. An alternate source could be the Upper Krishna region where several factory sites of the long-blade industry of chert have been recently discovered. Schist stone available near the Abu hills was occasionally used as touchstone and for making small conical objects which served as pendants, gamesmen or weights. Porpheretic schist came in handy for making pounders and amphibole schist for bowls and spheroid and conical weights. Granite has been used very sparingly for crucibles, pounders and whetstones. Sandstone was used for making spheroid weights in period B.

Among the fine-grained varieties of stone, with hardness varying from 5 to 7 of moh's scale and used for preparing weights are chert, agate, jasper, carnelian, amazon stone, chalcedony, amphibole schist, hornblende and felspar. Black schist and sandstone are rarely used. Except jasper, other fine-grained varieties must have been imported from the Narmada valley and elsewhere. Sandstone in the process of formation was noticed in the course of the excavation at Lothal at a depth of 19 ft below the present surface. Fossiliferous sandstone, granite and miliolites are among the varieties of stone used as anchors. Mention may be made of sandstone slabs used as anvil (pl. L B), for pavement in the bathroom and occasionally as cover for the privy. (Pl. XXVI A).

Besides beads and small weights one hundred and fifty stone objects have been found at Lothal. Functionally they are divided into (a) objects of domestic use, (b) craftsmen's tools and (c) machanisms of trade.

2. OBJECTS OF DOMESTIC USE

Pounders, querns and mullers made of sandstone and granite (pls. CCL-B-C and CCLI A) were used for grinding corn. Among the few stone vessels found at Lothal a bowl deserves to be mentioned (pl CCLVII). Parallel-sided blades of chert which served the purpose of pen-knives and sickle-blades are numerous. They are described under tools.

A. Rotary Mill (Fig. 120, 1 pl. CCL A)

A unique type of rotary mill in sandstone made in two parts was used at Lothal in Period B but only the upper part consisting of a heavy circular wheel with a narrow concave

neck and wide feeding mouth on top has been recovered. The square opening in the neck was meant for fixing a horizontal wooden bar to facilitate movement. On stratigraphical evidence it can be safely dated to the first half of the second millennium B.C.

B. Saddle Querns

Normally querns are made of sandstone and granite and they are ovoid on plan with an irregular section varying from concavo-convex to plano-concave (fig. 120, pl. CCL C) The undersurface is roughly chiselled so as to prevent rocking while in use. Of the heavier type only one quern of large size has been found at Lothal, whereas Rangpur has yielded several such ones. The larger querns with rough undersurface must have been fixed in the ground. The length of the querns varies from 12 to 18 inches.

C. Mullers

Mullers are generally ovoid on plan with a biconvex or plano-convex section (pl. CCLI A). A few of them have a circular or ovoid section. On account of the use the undersurface of the mullers is slightly convex, but there are two specimens with a flat undersurface. The material used is granite, sandstone and schist.

D. Pounders (pl. CCLI B)

Pounders are divided into two groups on the basis of their shape although both served the same purpose. The first group includes those which are spheroid, elliptical or ovoid on plan with an ovoid or round section. The second group is rectangular, triangular or cylindrical on plan with a rectangular or ovoid section. The material used is schist, granite, phospheretic schist and sandstone the hardest variety, namely, granite being more common. Most of the pounders have a rough pitted surface at one or both the ends suggesting that they have been used, but the sides are generally smooth. Spheroid pounders bear marks of use on all the sides. Sometimes rolled pebbles with irregular section were also used straight away as pounders without being dressed further. The majority were however chiselled and polished to a predetermined shape such as an oval, cylinder or sphere.

E. Dishes and Bowls

Only one dish in ossiferous syenite (pl. CCLVII A) has been found at Lothal. It has a low flat rim and a sagger base. Another occurs in gneiss. A bowl made of Amphibole schist has also been found.

3. TOOLS AND WEAPONS

Stone was as much a necessity to the craftsmen as to the trader and the housewife. Burnishers and polishers were needed by the potter and tanner, whetstones by the cobbler, moulds, anvils, touchstones, hammerstones and crucibles by metalsmiths and mace-heads by many other craftsmen. The very fact that a large number of stone tools have been found shows that stone was in great demand in spite of the scarcity of the material.

A. Polishers and Burnishers

Fine-grained chert pebbles are found to have been shaped into burnishers for smoothening pottery surface, (pl. CCLXII A), while granite was used for making floor polishers. The polishers and burnishers are more or less of the shape of a lunate; very few of them are elliptical. The section is generally rectangular with truncated corners on the working side.

B. Whetstones and Touchstones

Whetstones are made of sandstone, granite and schist. They are roughly rectangular on plan with a circular or rectangular section. One of them has a smooth surface (pl. CCLII A) and is very similar to the whetstone used by modern cobbler for sharpening tools. The touchstone of black schist (pl. CCLII A..) found at Lothal must have been used by goldsmiths.

C. Hammerstones and Maceheads

Several perforated cylindrical stones, circular in section, are found at Lothal. They must have been hafted in wooden handles and used by metalsmiths as hammers. Lothal has also yielded unperforated ovoid objects of stone which must have been used as meceheads and hafted in split wooden handles secured with lashings. Marks of use are clearly visible on them. The maceheads from the Indus valley are generally lenticular in section, whereas those of Lothal are circular.

D. Net-sinker

Only one specimen of a conical net-sinker with a small hole right through has been found in sandstone. It must have been suspended by means of a string passing through the hole. It could also be used as a loom-weight.

E. Crucibles and Moulds

A small bowl-shaped crucible of sandstone recovered in the excavations (pl. CCLIII A) appears to have been used for melting metals.

Two rectangular slabs of sandstone with groove-like depressions were used as moulds for casting pins and needles of copper and bronze. One of them has three grooves and the other only one. Mackay has considered similar stones as whetstones, but it may be noted that deep grooves are not useful in sharpening tools. The wire-like pins and needles found at Lothal must have been cast in the stone moulds.

F. Sling Balls (pl. CCLIII B)

Sling balls are more numerous in Period B than in Period A and are usually spheroid in shape.

G. Blades (Pl. CCLIV-CCLV A)

Inspite of the non-availability of fine grained chert locally the Lothal folk produced thousands of parallel-sided blades from the imported material. The occurrence of blades in such large numbers suggests that they were in great demand and must have been used for several purposes. Primarily they served as domestic pen-knives and sickle-blades.

The Sukkur-Rohri region may have been one of the sources of supply of the raw material the other one being of Kaladgi series of the Upper Krishna region. The primary flakes, fluted cores and blades with crested-ridge found at Lothal suggest that the technique of crested-ridge-guiding technique was followed by the blade-maker. Even large flakes obtained in the process of trimming the core have been used as blades and scrapers Fig 123, *13-18*). It is possible to obtain long and uniformly-thin blades as the texture and fracture of chert is suitable for the purpose. Moreover, the cores are long enough. Owing to the stoppage of import-trade in Period B other substitutes like agate, chalcedony and jasper which are also siliceous derivatives and available locally were used for making short blades. The small size of the pebbles of jasper and chalcedony available in the beds of Sabarmati, Bhadar and other rivers was responsible for the diminished sized of blades, although the crested-ridge-guiding technique was followed in Period B also. Hence the classification of blades into long and short ones is based on size and material. Further subdivision is based on shapes as well as function. This distinction in material and size of blade is applicable to other Harappan and Late Harappan sites as well. As a general rule long blades of chert have trapezoidal or triangular section and, in most cases, the proximate end shows the bulb and diffused platform. There are some blades in which the bulbar end was deliberately knocked off. Further details regarding secondary working of the tools are given typewise in the following paragraphs.

Type I (fig. 122, *1-5*) is a typical long parallel-sided blade carefully removed and has a razor-sharp working edge. *Sub type Ia* is distinguished by its edges which retain the primary flake-cut and the section is trapezoidal and occasionally triangular. A majority of the blades has the bulb of percussion and striking platforms which indicate careful workmanship. *Sub-type Ib* has a curve at the distal end which is slightly narrower than in the subtype Ia. *Sub-Type Ic* consists of thin short flakes worked into blades which show a small bulb and platform.

Type II (fig. 122, *6-12*). Unmistakable marks of use as pen-knives or sickle blades are seen on the margins in this type. *Sub-type IIa* shows marks of use on one margin while the other retains fresh flake-out. The *sub-type IIb* which accounts for the bulk of blades in type II is chipped on both the margins due to use. *Sub-Type IIc* consists of narrow blades with signs of use, whereas the *sub-type IId* is characterised by the converging margins bearing marks of use.

Type III (fig. 122, *13-16*). This type is distinguished by the close retouch on one or both margins whereas type II had no retouch at all. *Sub-type IIIa* has both the margins retouched and subsequently polished. *Sub-type IIIb* shows retouching on one margin but use-marks are noticeable on both margins. *Sub-type IIIc* shows retouching on both margins, but marks of use are not clear. It is sometimes difficult to differentiate between deliberate trimming and chipping due to use.

Type IV (fig. 122, *17*). This type consists of backed blades wherein steep retouch and use-marks are visible. Some of them show the bulbar scar and platform.

Type V (fig. 122, *18*). This can be recognised by the deliberate grinding of both the margins but no eviednce of use or secondary retouch is noticeable. A few of the blades could have been used as burnishers.

TYPE VI (fig. 122, *19-20*). This type consists of minutely retouched blades which were originally used for cutting purposes, but were subsequently ground and polished for being used as burnishers etc. In some cases one of the margins is ground and the other steeply retouched. *Sub-type VIa* has finely retouched margins. *Sub-Type VIb* has one edge steeply retouched and the other polished.

TYPE VII (fig. 122, *21-22*). This consists of sub-triangular blades with retouched margins converging towards the distal end. They could be used for cutting as well as piercing. *Sub-type VIIb* has both the margins ground to produce a point at the distal end.

TYPE VIII (fig. 123, *1-2*). This has one of the working edges meticulously trimmed to produce a fine serrated edge.

TYPE IX (fig. 123, *3-4*). It has an oblique cut at the distal end producing a pen-knife end.

TYPE X (fig. 13, *5*). It has both its working edges chipped due to use, and the coverging sides produce a point at the distal end. Some of the specimens show retouching near the point.

TYPE XI (fig. 123, *6-7*). This has an oblique cut at the base producing a shoulder for hafting.

TYPE XII (fig. 123, *8*). It is a notched blade, the notch being produced on one of the margins and is slightly retouched. Use-marks are also seen.

TYPE XIII (fig. 123, *9*). It is a blade-cum-engraver with retouching in some cases at the the projecting tip.

TYPE XIV (fig. 123, *10*). This has a truncated upper end resulting in a gruelling point.

TYPE XV. (fig. 123, *11*). It is a blade produced on a narrow flake with marks of use on both the margins. It has a pronounced tang at the distal end. The platform and bulb are visible in a few cases.

TYPE XVI (fig. 123, *12*). This consists of blade-scrapers wherein both the margins show chipping due to use in addition to the deliberate secondary working at the distal end.

H. ASSYMETRICAL FLAKES

TYPE XVIII includes assymetrical flakes a few of which were retouched. Most of them were used as scrapers or blades and therefore show marks of chipping due to use. (fig. 123, *13-18*).

I. LUNATES ETC

TYPES XVIII TO XX consists of short parallel-sided blades and lunates of jasper and chalcedony mostly brought into use in Period B.

TYPE XVIII is a lunate with fine retouching on the chord. In a few cases the arc is also retouched (fig. 124, *1-5*).

TYPE XIX includes short parallel-sided blades with or without retouch (fig. 124, *6-8*). *Sub-type XIXa* shows fresh flake-cut on both margins while in *Sub-type XIXb* a steep or shallow secondary retouch is noticeable on both margins.

TYPE XX shows converging margins steeply retouched towards the distal end resulting in a shart point (fig. 124, *9*).

TYPE XXI is represented by a solitary blade with a crested-ridge on the back (fig. 124, *13*).

J. Cores (fig. 124, *10-12*)

Apart from the tools mentioned above three types of cores are found at Lothal. One of them is an excellent specimen of a conical fluted core from which parallel sided blades were removed. Another shows the ridge. Small cores of jasper and chalcedony are also found at Lothal. A few of them retain negative scars of short narrow blades taken out from them. In another instance discontinuous flake-scars indicating the failure to take out complete blades are seen.

4. WEIGHTS (pls. CCLVII B—CCLIX B fig. 125)

A. Material

One of the most striking features of the Indus Civilization is the adoption of an accurate and common standard of weights throughout the territory occupied by them. They preferred hexahedron weights of chert to any other shape and material although their contemporaries used duck-shaped and barrel-shaped weights in the Nile and Euphratis-Tigris valleys. The Lothal folk also rigidly followed the standard obtaining in the Indus Valley (Table XVII) and actually imported well-polished weights of chert etc., from outside, as suitable material was not locally available. Besides chert, banded agate, jasper and schist were made use of. Two cubical weights of carnelian have also been found at Lothal. It is interesting to note that the truncated spheroid weights were more popular in Period B than in Period A. The occurrence of two barrel-shaped weights at Lothal and cubical ones at Ur, Kish, Brak Susa etc., suggest a vigorous trade between the Harappans and Sumerians.

B. Types

According to shapes the stone weights from Lothal may be divided into five groups (1) hexahedrons, (2) spheroids with a flat base and top, (3) cylindricals, also with a flat top and base, (4) conicals with or without holes, and (5) barrels, but excepting the first group others do not yield a regular ratio nor do they conform to any known standard. Except for occasional wear-outs they are the most perfect and great skill is exhibited in chipping and polishing them. The edges are slightly rubbed so as to protect them from damage. They vary from 0·375 inches square on plan and 0·25 ins. in height to 1·6 ins. on plan and 1·25 ins. in height. These weights in phases II to IV and a few in phase V also. Cubical weights of chert are reported from Tepe Gawra, Kish, Susa, Brak etc., (above p. 231).

Numerically the truncated spheroids with flat base and top come next to cubicals. They are normally made of black schist and banded gneiss, rarely in chert and have a smooth surface. They vary in diameter from 1·26 to 1·5 inch at the equator with a height of 0·8 inch. At the top the diameter is 1 in. or less. A highly polished semi-spherical weight weight in amphibole schist from phase IV weighs 300 gms.

The few specimens in gneiss, chert etc., found at Lothal come from phases III and IV. Truncated spheroids made of dolerite and sandstone are numerous and occur mostly in Period B. As already remarked they are not made in any particular ratio and may not have been had as weights.

Cylinderical objects with a flat base and top are very rare. Only two specimens are found at Lothal. They are well made but the bigger one is damaged. The smaller one is 0·37 inch long and 0·6 inch in diameter at the poles and the bigger on 0·75 inch long.

The fourth group consists of conical objects with a flat base and truncated top. They are made of chert and black schist. One of them, made of chert, has three blind holes which might have been advisedly effected for rectifying the weight as to conform to the regulated standard. The two specimens illustrated weigh 194·2 g. and 135 g. and their height is 2 and 1·75 inches respectively.

Small conical objects with a button top and a horizontal groove below it are mostly made of agate and rarely of jasper and steatite. They have been carefully examined, weighed and tabulated assuming them to be weights but not pendants or gamesmen. Still considering their uniform shape and the varying sizes one is inclined to construe them as weights especially because the ratio 1:4:6 is roughly obtained. They occur in all the phases and measure from 0·32 inches to 0·75 inches in height.

The fifth class of weights is a barrel-shaped one. Among the two specimens found here one is highly polished. They weigh 203·6 g. and 54·0 and are found in the third and fourth phases respectively. It has been rightly surmised that barrel-shaped weights were inspired by the shape of weatcorn which the ancient people had to use as the medium of exchange in a barter economy. It was a common type in most of the West Asia sites. The two weights under reference appear to have been imported.

C. Standards

(i) Lothal Standards

Twentyseven weights were studied by Sri B. R. N. Sharma and a summary of his report is given below.[1] The specimens have been accurately weighted, correct to the fourth decimal place and their specific gravity is also calculated wherever possible. Shri Sharma has worked out the ratios and prepared the four tables appended here. According to him the determination of the specific gravity of a specimen helped, among other things, in verifying the identity of its material. For example the average of the specific gravities of six specimens made of chert (Nos. 1, 2, 3, 4, 5 and 7) was found to be 2·7. This agrees well with the value for chert.

A second use to which a knowledge of the specific gravity was put is the calculation, in cases of badly chipped specimens, of their weight when they were undamaged. As an instance, specimen No. 1 of cubical shape is badly chipped. Its actual volume was measured by displacement of water. It was then dried, and accurately weighted, and its specific gravity was thus calculated. As the specimen has still some edges intact, it was possible to calculate the volume it must have had when it was complete. Multiplying this volume by the specific gravity, Sharma calculated the weight of the original specimen.

Even a superficial examination of the weights of the specimens shows that they fall into groups in simple ratios to one another. The specimens were analysed on the lines followed by Hemmy.[2]

Taking the smallest Harappa weight as unit, it was found that the mean weights of the various groups of cubical weights among the present specimens were in the simple ratio of 2, 4, 6, 8 and 16 etc. The mean weight of each group was then divided by this ratio and multiplied by the number of specimens. The products of all the groups were added together and divided by the total number of specimens. This gave the mean value of the unit-weight. The mean value of all the other groups is then obtained by multiplying

[1] I am obliged to Sri Sharma for his analysis ; also see Appendix II.

[2] Marshall *op. cit.* II, 1931 p. 589 ff.

the mean value of the unit-weight by the respective ratio of the particular group. The particular group. The difference between the mean values observed and mean values calculated is due to the fact that the number of specimens studied is very limited and that some of them are slightly chipped or worn.

Table XVI (Cubicals)

Designation	No. of specimens	Mean wt. observed (in grams)	Limits		Ratio	Calculated value in grams.
			Lower	Upper		
1	2	3	4	5	6	7
A	3	1.712	1.6078	1.8233	2	1.764
B	1	3.5305	—	—	4	3.448
C	1	5.2256	—	—	6	5.172
D	7	7.238	6.8316	7.6025	8	6.896
E	2	13.673	13.673	13.7000	16	13.792
F	4	27.147	27.0482	27.2649	32	27.584
G	3	54.041	53.2390	54.6008	64	55.168
H	1	125.800 (136.6)*	—	—	160	137.900

*In this case, as the specimen is badly chipped, the probable weight of the specimen when it was whole was calculated as described above.

However, five of the cubical weights are observed to fall into a different series. Giving the value of unit to the smallest weight of 1·2184 grams, the other weights are in the ratio 7/2, 7, 14 and 28. They are given designations A', B' etc., etc., and listed in Table XVII to facilitate differentiation of this series from the first series listed in Table XVI. Considering the very small number of weights forming the second series, the regularity of the ratios is remarkable.

Table XVII (Cubicals)

Designation	No. of specimens in each group	Specimen number	Weight (in grms)	Ratio
A'	1	2.	1.2184	1
B'	1	12	4.3370	7/2
C'	1	13	8.5753	7
D'	1	21	18.1650	14
E'	1	23	32.3052	28

Table XVIII

Specimen number	Condition	Shape	Weight (in grms.)	Designation
1	Bc	Cubical	125.8004	H
2	Sc	,,	54.6008	G
3	C	,,	53.2390	G
4	Sc	,,	27.2354	F
5	C	,,	54.2826	G
6	Sc	,,	27.1461	F
7	P	,,	13.6468	E
8	P	,,	13.7000	E
9	C	,,	6.8316	D
10	P	,,	7.6025	D
11	Sc	,,	6.8608	D
12	P	,,	4.3370	B
13	P	,,	8.5753	C
14	Sc	,,	7.1500	D
15	P	,,	1.8233	A
16	Sc	,,	5.2256	C
17	P	,,	3.5305	B
18	P	,,	1.6078	A
19	P	,,	1.7030	A
20	P	,,	1.2184	A
21	C	,,	18,1650	D
22	C	Truncated spheroids	27.0482	F
23	Sc	,,	32.3052	E′
24	C	,,	7.4218	D
25	F	Cubical	27.2649	F
26	Sc	,,	7.4492	D
27	P	,,	7.3533	D

Note P—Perfect, C—Chipped, Sc—Slightly chipped. Bc—Badly chipped.

The attempts made at tracing the possible relationship between the weight standard of Lothal and some of the known weight standards in ancient India such as the Ratti-seed or Raktika and Dharana, did not yield any satisfactory result. The average weight of a Raktika is 1·823 grains and the value of a Dharana is 24 Raktikas as mentioned by the ancient astronomer, Gopala Bhatta.[1] In other words the value of a Dharana is 43·75 grains i.e., 2·836 grams. As none of the Lothal weights is in a simple ratio to this value it is not possible to establish any relationship with the ancient weight-standards. The results of weighing the conicals with a button top and variously described as pendants and weights are given in Table XIX below. It may be noticed that the values of these weights do not

[1] *Journal of the Royal Asiatic Society* (Calcutta, 1937), pp. 1-26.

bear any simple relationship to one another. Hence the possibility of these objects being weights is rather remote.

Table XIX

Specimen number	Weight in grams
1	1.8576
2	2.1524
3	0.2878
4	1.5871
5	3.0332
6	1.5351
7	1.1268
8	2.0929
9	1.4212
10	1.2332
11	1.4496
12	0.4976
13	0.7288
14	1.9229
15	0.8342
16	0.8903
17	2.7294
18	0.6063
19	0.6661
20	0.1787
21	1.2480
22	0.1970

(ii) Indus and Babylonian standards

It is interesting to note that in the Babylonian system, the mean value of a shekel is 8·40 gms.,[1] while it is 8·35 gms. in the Heavy Assyrian system and 8·37 gms. in the Babylonian system at Susa. The A group of Lothal in table XVII above weighs 1·764 gms. corresponding roughly to the mean weight of B group (1·76) from the Indus Valley, which in turn is equal to the weight from Niffer (cat. No. 959c of the British Museum)[2]. The B group from Lothal weighing 3·448 corresponds to the D group of the Indus Valley, weighing 3·41 gms. There are two weights in the British Museum both weighing 3·45 gms. One of them is from Sippara (cat. No. 982c) and the other from Niffer (cat. No. 959c). The D group of Lothal weighing 6·896 corresponds to the E group of the Indus Valley weighing 6·82 and to the Susain shekel (?) of 6·80 gms. (cat. No. 56). The mean value of the shekel in the Babylonian system from Susa is 8·37 gms. There is but one specimen weighing 8·5753 in the C' group adopted this standard also from Lothal. In the Heavy Assyrian system 1/8 Mina weighs 125 gms. which happens to be the weight of H group in Table XIX from Lothal.[3]

[1]Marshall *op. cit.* II, 1931 p. 594.

[2]*Ibid.* p. 595; Table IX.

[3]For further discussion on Indus metrology see Appendix II.

There are some heavier weights, mostly of sandstone, schist and rarely agate, which do not yield any ratio or correspond to any known system. Their weights are however given below.

Table XX

S. No.	Weight in gms.	Shape
XI	300.0	Spheroid
II	280.0	,,
I	275.1	,,
III	271.2	,,
V	229.5	,,
IV	203.6	Barrel
IX	194.2	Conical
XII	156.0	Spheroid
X	135.0	Conical
XIII	98.2	Spheroid
VI	54.0	
VII	33.1	Barrel

5. STONE ANCHORS (pls. CCLXA—CCLXI A; fig. 126)

The recent progress in marine archaeology has made it possible to understand the use of pierced stones as anchors. Bronze Age anchors have been recorded at the ancient ports of Tyre and Byblos. Besides the size and shape of the stone used for the anchor, the number of perforations it has and the marks of use are important in determining the sea-bed and size of the ship. The modern sailing ships from Malabar Coast reaching Bhavanagar and Dwaraka are 60 ft. long. The Bronze Age ships of Lothal also must have been of the same size, for one of the boats painted on a potsherd has 12 pairs of oars. Unless a boat is about 60 ft. long it is not possible to have so many pairs of oars. In this connection it may be noted that the Minoan ships were 21 metres long. Honor Frost who has made a special study of ancient anchors has classified stone anchors into three types on the basis of function. First comes the simple weight-anchor used on a rocky bottom but it tends to drag on sand. The second type is the 'sand-anchor' consisting of a small flat stone with three or more holes. Through two holes sticks are wedged on either side so that the anchor can be engaged on the sand and rope may be passed through the third one. The third type is a composite one which can be used on rock or sand. It is triangular with a hole at the apex for the rope and two holes in the base for the sticks to project. Egyptians and Phoenicians used both round and triangular anchors, the latter being more popular. Out of seven stone anchors found at Lothal, five come from the basin of the dock, one from the nullah through which ships entered the dock and one from the township between Blocks C and D. Four anchors are of roughly-hewn lime-stone, two of sandstone and one of miliolites. The triangular anchor has a hole at the apex but none at the base. Among the larger ones which are roughly hewn two anchors have only one hole each in the centre and the marks of wear-out caused by the rope are also visible. The remaining four anchors have one large central hole and atleast two smaller ones near the margin or centre. These smaller perforations were meant for fixing wooden sticks so as to engage the anchors in sand or silt. It is evident that the Lothal sailors used the composite and rock anchors.[1]

[1]See Appendix II for technical report of oceanographers regarding Lothal dock.

Rotary mill (Pl. CCLA)

Upper half of a rotary mill; white sandstone; conical with a disc-top and circular section. A circular feeding mouth at the top and a square opening below the neck for fixing a wooden handle horizontally. From phase V, Period B. (No. 13550) (fig. 120, *1*). Similar querns are noticed at Navasa.[1]

Pedestalled quern and muller. Pl. CCLB

1. Quern; sandstone; rectangular, tabloid. Working surface slightly concave owing to use. Rectangular solid base suggests portability. From phase III, Period A (No. 15331a).

2. Muller; sandstone; cylindrical circular. Signs of use visible. From phase III, Period A. (No. 15331b).

Querns. Pl. CCL C

1. Red sandstone; ovoid; concavo-convex section; deep depression on the working surface; thick unhewn base for fixing in the ground. From phase IV. Period A. (No. 15316) (fig. 132, *2*).

2. Granite; assymetrical, almost tabular with a low depression. Damaged. From phase II, Period A. (No. 15304).

3. Granite; elliptical, rectangular. Both surfaces smoothened due to use. Damaged. From phase IV, Period A. (No. 15305).

4. Sandstone; circular, plano-concave. Both surfaces smooth. Damaged. From phase III, Period A (No. 15309).

Mullers. Pl. CCLI A

1. Gneiss—highly metamorphosed; ovoid; plano-convex. From phase IV, Period A. (No. 413).

2. Sandstone; ovoid. Plano-convex sides smoothened due to use. From phase III, Period A. (No. 15296). fig. 120, *2*.

3. Schist; rectangular in plan and section with ground edges, surface smooth. From phase III, Period A. (No. 15321).

4. Sandstone; ovoid, biconvex, use marks on surface. One end tapering. From phase IV, Period A. (No. 15325). fig. 120, *3*.

5. Red sandstone; circular; plano-convex; surface very smooth. Damaged. From phase II, Period A. (No. 2668). fig. 120, *4*.

6. Red sandstone; ovoid; plano-convex: smooth on the undersurface and chipped on upper surface, Damaged. From phase V, Period B. (No. 15320).

Pounders Pl. CCLI B

1. Gneiss; cylindrical but slightly tapering at one end; triangular section. From phase I, Period A. (No. 489). fig. 120. *5*.

2. Syenite; ellipsoid, lenticular—use-marks visible on ends. Damaged. From phase II, Period A. (No. 4620). fig. 120, *6*.

3. Red sandstone; rectangular; roughly tabloid; one side smooth; use-marks on ends. From phase IV. Period A. (No. 14887). fig. 120, *7*.

4. Granite; rectangular, tabloid; tapering at one end. Use-marks on ends. From phase V, Period B. (No. 14885). Fig. 120. *8*.

[1] H. D. Sankalia and others: *From History to Prehistory at Nevasa* (Poona, 1961) p. 478; figs. 109-200.

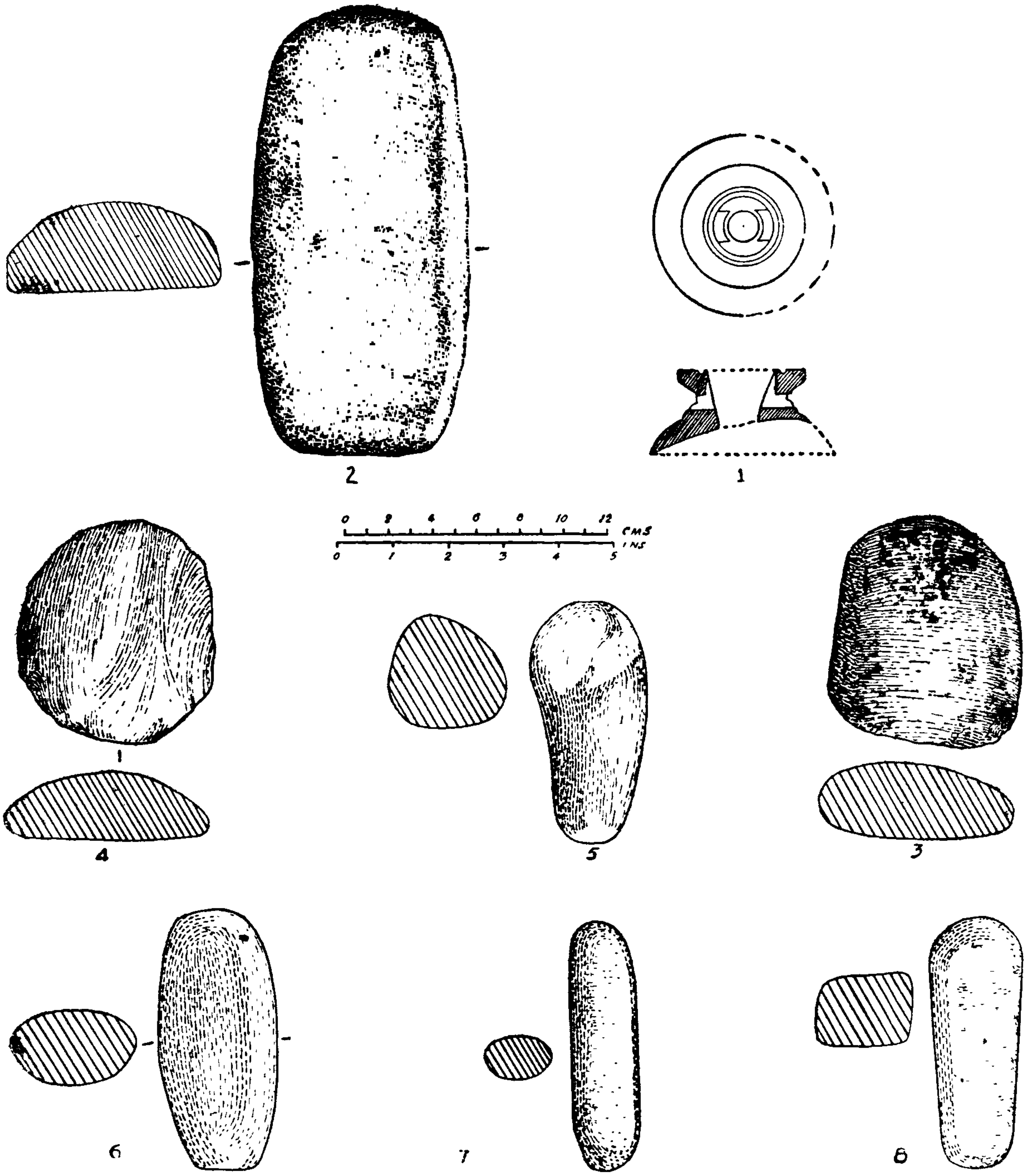


FIG. 120. *Rotary mill, querns, mullers and pounders.*

5. Granite; rectangular, tabloid, smooth surface. Use-marks on ends. From phase V, Period B. (No. 523).

6. Granite; rectangular, tabloid, smooth surface. use-marks on one end. From phase II, Period A. (No. 13384).

Whetstones etc Pl. CCLII A

1. Syenite; cylindrical, elliptical; curved at one end for sharpening tools. Smoothened by use. From phase III. Period A. (No. 15328). Fig. 121, *1.*

3. Syenite; rectangular, lenticular section at the narrower end and rectangular at the broader end. Deep. oblique grooves intended for re-sharpening the pointed tools. From phase III, Period A. (No. 15327). Fig. 121, *2.*

3. Tawny chert; rectangular on plan and section extremely smooth on used surface. From phase II, Period A. (No. 3876).

Moulds. Pl. CCLII B

1. Granite; rectangular in plan and section; grooves for casting pins and awls are three on one side, one each on the remaining three sides and none on the ends. Average length of the groove 3 ins. and breadth 1/30th in. From phase III, Period A. (No. 15297). Fig. 121, *3.*

2. Sandstone; rectangular, tabloid. Four shallow grooves and one deep groove on one side only. Groove 5 ins. long, 1/8th wide and 1/10th in. deep. From phase II, Period A. (No. 15323). Fig. 121, *4.*

Maceheads. Pl. CCLIII A

1. Granite; conical circular with 3/8 in. wide axial hole; From phase III, Period A. (No. 15299). Fig. 121, *5.*

2. Granite; barrel. circular with an axial hole, 1 in. wide. Damaged. From phase IV, Period A. (No. 19299). Fig. 121, *6.*

3. Granite; truncated barrel, circular with 1 in. wide axial hole; From phase II, Period A. No. 15239. Fig. 121. *7.*

Sling balls. Pl. CCLIII B

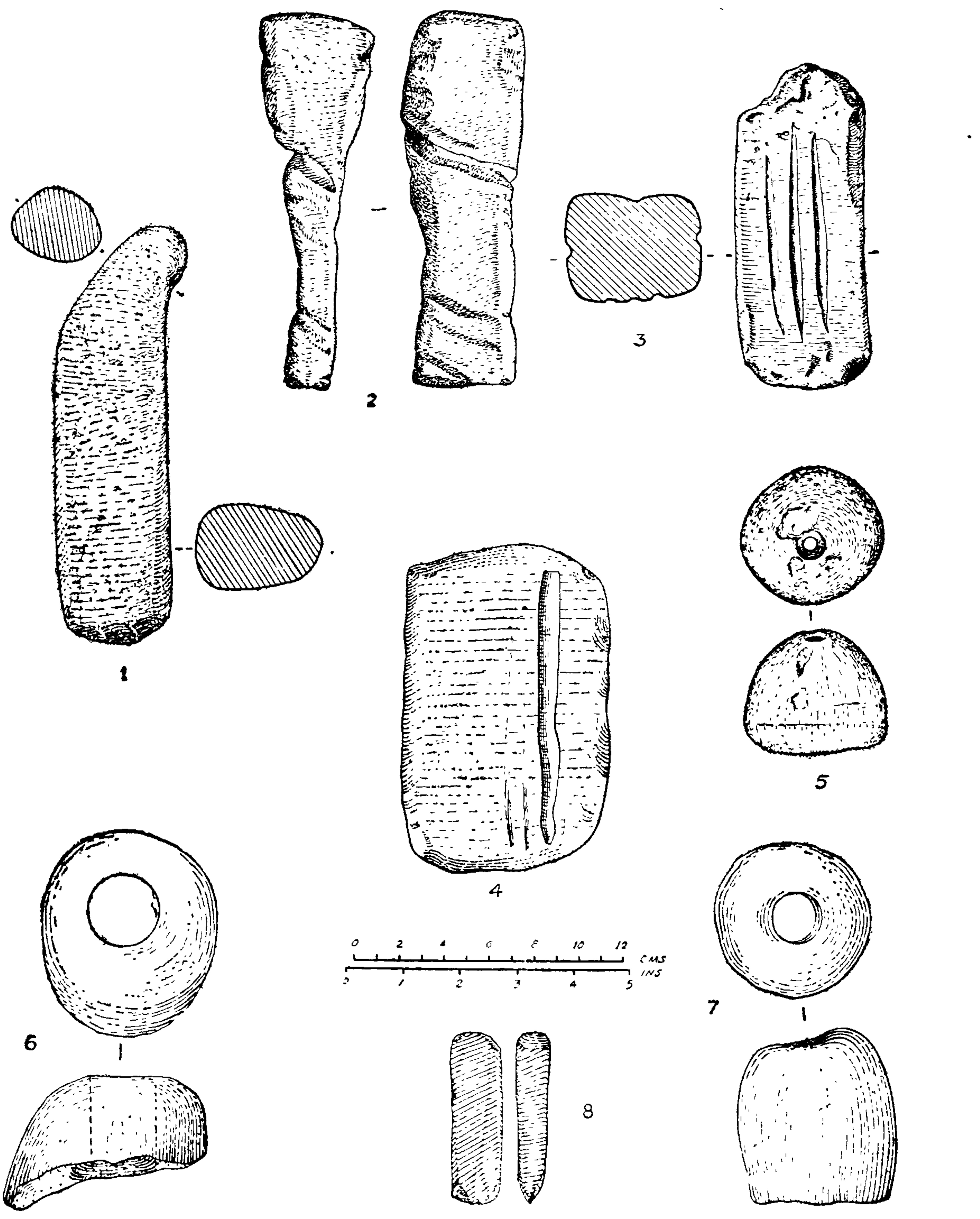
1. Red sandstone; spheroid; circular. From phase III, Period A. (No. 14881).
2. Granite; spheroid; circular. From phase V, Period B. (No. 433).
3 Red sandstone; spheroid; circular From phase II, Period A. (No. 15315).
4. Granite; other particulars same as above. From phase IV, Period A. (No. 15312).

Parallel-sided blades Pl. CCLIV; Fig. 122.

1. Chert; ashy grey; sharp edges of primary flaking; trapezoid transverse section; Platform and bulb visible; transverse cut at the distal end. Parallel-sided blade. *Type Ia.* From phase III, Period A. (No. 7529).

2. Chert, buff; fresh flake-cut retained on both the margins; triangular transverse section; Platform and bulb visible; broken at the distal end. Thicker than No. 1 above. Parallel sided blade. *Type Ia* From phase II, Period A. (No. 14661).

3. Chert; yellowish with dark patches and whitish bands; both margins retaining primary flake-cut; long and narrow flake of trapezoid transverse section. platform very insignificant; diffused bulb of percussion; thick and curved at distal end perhaps due to the conical shape of core and hings fracture. Parallel-sided blade. *Type Ib.* From phase I, Period A. (5097).



FIG, 121. *Whetstones (1-2), moulds (3-4), mace-heads (5-7) and chisel (8)*

4. Chert; brown; both margins retaining primary flake-cut; long narrow flake of triangular transverse section. Striking platform visible; bulb of percussion at the proximal end; distal end curved and narrow. Parallel-sided blade. *Type Ib*. From phase IV, Period A. (No. 10889).

5. Chert; ash grey; Thin narrow flake with both margins retaining primary flake cut; trapezoid transverse section; Striking platform; Very insignificant bulb of percussion visible. Broken at the distal end. Parallel-sided blade. *Type Ic*. From phase IV, Period A. (No. 6495).

6. Chert; slightly ashy; one of the margins chipped due to use and the other retaining fresh flake-cut; trapezoid transverse section; broken at the distal end. Platform and bulb visible. Parallel-sided blade. *Type IIa*. From phase IV, Period A. (No. 2369).

7. Chert; ashy grey; one of the margins chipped due to use and the other retaining fresh flake-cut; flake of flattish trapezoid transverse section, broken at the bulbar portion and having an incurved and slightly tapering distal end probably due to the conical shape of the core. Parallel-sided blade. *Type IIa*. From phase II, Period A. (No. 5609).

8. Chert; tan brown; both margins chipped due to use; long flake of trapezoid transverse section. Striking platform; bulb of percussion visible at the proximal end. Parallel-sided blade. *Type IIb*. From phase I, Period A. (No. 3394).

9. Chert; Yellowish; both margins chipped due to use. Long flake with trapezoid transverse section showing platform and bulb; broken at the distal end. Parallel-sided blade. *Type IIb*. From phase III, Period A. (No. 2064).

10. Chert; yellowish brown; both margins chipped due to use; narrow flake of triangular transverse section. Broken at both ends. Parallel-sided blade. *Type IIc*. From phase II, Period A. (No. 3069).

11. Chalcedony; translucent; working edges chipped due to use; short narrow flake of triangular transverse section. Platform and bulb visible; broken at the distal end. Parallel-sided blade. *Type IIC*. From phase IV, Period A.(No. 9901).

12. Chert; brown; both margins chipped due to use; thin and narrow flake of triangular transverse section with converging margins at one end. Broken at the proximal end. Parallel-sided blade. *Type IId*. From phase V, Period B. (No. 12730a).

13. Chert; ashy grey, fully retouched along one margin and partially along the other. Use-marks visible. Flake of triangular transverse section; Broken at both ends. Parallel-sided blade. *Type IIIa*. From phase IV, Period A. (No. 12883).

14. Chert; light grey; one margin retouched and the other rendered smooth by polishing the broken edge. Flake of trapezoid transverse section; broken at the proximal end. Signs of hinge-fracture noticed at the incurved distal end. Stain of red pigment on one side. Parallel-sided blade. *Type IIIb*. From phase III, Period A. (No. 5987 (b).

15. Chert; light yellow, both margins retouched and one of thste steeply. Flake of flattish trapezoid transverse section; broken at both ends. Damaged. Parallel-sided blade. *Type IIIc*. From phase IV, Period A. (No. 2706).

16. Chert; yellowish; both margins retouched but one of them broken due to use. Flake of triangular transverse section; Platform visible but broken showing bulb of percussion; broken at the distal and. Parallel-sided blade. *Type IIIc*. From phase V, Period B. (No. 12898).

17. Chert: pale grey; both the working edges retouched steeply. Flake of trapezoid transverse section; with both ends broken. Parallel-sided blade. *Type IV*. From phase II, Period A. (No. 13551).

18. Chert; light grey; one of the margins steeply retouched, and the other very well ground deliberately for grip. Flake of trapezoid transverse section with broken ends. Slightly used. Parallel-sided blade. *Type V*. From phase IV, Period A. (No. 5891(a).

19. Chert; greyish; banded; finely retouched and partly polished on both edges. Long narrow flake of trapezoid transverse section with broken ends. Irregular cuts on one edge and the other retouched edge polished. Having used the tool as a blade or cutting instrument in the first instance it might have been used subsequently as a burnisher after polishing it. Another possibility is that the polished surface is the result of using the blade as a grass cutter. Parallel-sided blade. *Type VIa*, From phase II, Period A. (No. 13543).

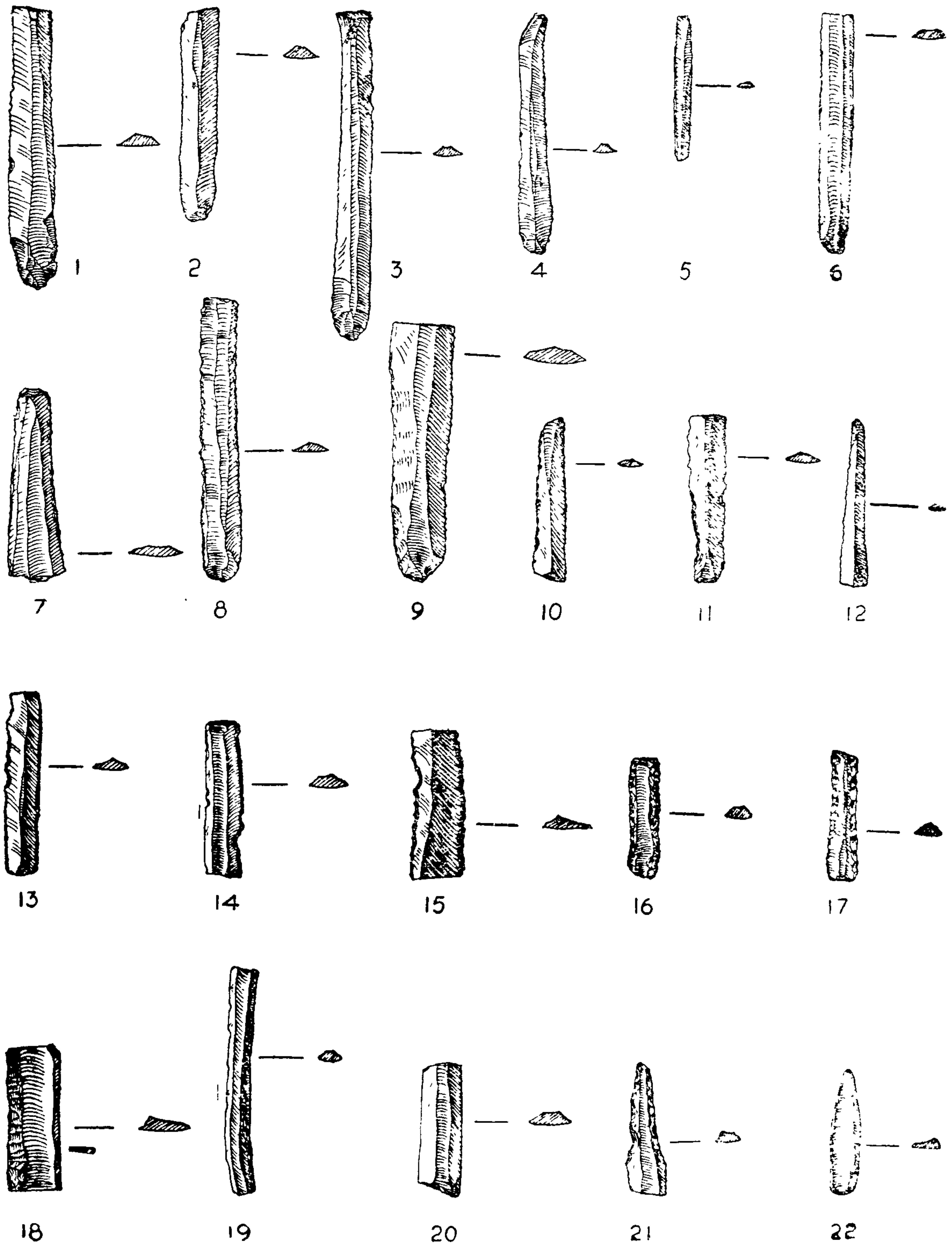


FIG. 122. *Parallel-sided blades. Scale ½*

20. Chert; chocolate with creamy patch; both margins well-ground; Flake of trapezoid transverse section with broken ends. Might have been used as a burnisher; Parallel-sided blade. *Type VIb.* From phase III, Period A. (No. 9348).

21. Chert; light yellow; both the lateral sides steeply retouched. Triangular flake of trapezoid transverse section with lower part of both the edges almost fresh due to primary flaking. The point produced by the tapering and steeply-retouched sides is blunt due to use as an awl; notched on one edge. Parallel-sided blade. *Type VIIa.* From phase II, Period A. (No. 3294).

22. Chert; yellowish both margins smooth with a developed point. Flake of flattish trapezoid transverse section, with bulbar end removed. Converging sides smooth due to grinding; but scars of original retouch visible. Parallel-sided blade. *Type VIIb,* From phase IV, Period A. (No. 6167).

Pl. CCVA; Fig. 123.

1. Chert; ashy grey; one of the margins chipped due to use. Flake of trapezoid transverse section. Platform and bulb visible at the bulbar end. One of the margins retouched in such a way as to produce a prominent saw edge. Broken at the distal end. Parallel-sided blade used as saw. *Type VIII.* From phase III, Period A. (No. 7125). occurs aι Kish also.

2. Chert; grey, banded; one of the margins finely retouched and the other serrated. Long flake of trapezoid transverse section; broken at the bulbar end. One of the margins retouched in such a way as to produce a saw edge. Parallel-sided blade as used as a saw. *Type VIII.* From phase V, Period B. (No. 8488).

3. Chert; creamy; both edges slightly chipped due to use. Thin narrow flake of trapezoid transverse section and slightly curved at the distal end. Shape of a blade of a pen-knife. Platform and bulb of percussion visible. Parallel-sided blade *Type IX.* From phase III, Period A. (No. 1171).

4. Chert; pale grey; both edges retaining fresh-flake cut. Narrow flake of trapezoid transverse section; broken at the bulbar end. Slightly curved at the distal end. Paalel-sided blade. *Type IX.* From phase V, Period B. (No. 3761).

5. Chert; brown; both margins retaining fresh flake-cut. Long flake of trapezoid transverse section with sides converging at the distal end into a blunt point; Slight secondary trimming on one edge at the point; Concave undersurface. Broken at the bulbar end. Parallel-sided blade. *Type X.* From phase III, Period A. (No. 14695).

6. Chert; grey, banded; one margin thick and finely retouched upto the shouldered end and the other margin ground and unused. Flake of trapezoid transverse section having broken ends. Parallel-sided blade. *Type XI.* Unstratified, period A. (No. 4).

7. Chert; pale grey; one margin steeply retouched and the other notched and ground after close trimming. Flake of trapezoid transverse section with broken ends. A transverse cut at the bottom end has produced a shoulder. Parallel-sided blade. *Type XI,* From phase I, Period A. (No. 4884).

8. Chert; yellowish brown; one margin showing irregular cuts due to use and the other notched and slightly retouched. Flake of trapezoid transverse section in one half and a triangular section near broken end. Parallel-sided blade. *Type XII.* From phase IV, Period A. (No. 7615).

9. Chert: ashy grey; banded; Beak-like projection at one end and both margins chipped due to use. Flake of flattish trapezoid transverse section, broken at both the ends. Parallel-sided blade which could be used as engraver. *Type XIII.* From phase III, Period A. (No. 7334).

10. Chert; grey; both margins chipped due to use. Flake of trapezoid transverse section having an oblique-cut at the upper end resulting in a gravette point. Broken at the bulbar end. Parallel-sided blade. *Type XIV.* From phase III, Period A. (No. 24).

11. Chert; whitish grey; both margins chipped due to use. Narrow flake of trapezoid transverse section with a pronounced tang at one end. Fine retouching on either side of the tang. A tiny platform and bulb seen at the opposite end. Parallel-sided blade. *Type IV.* From phase III, Period A. (No. 9533).

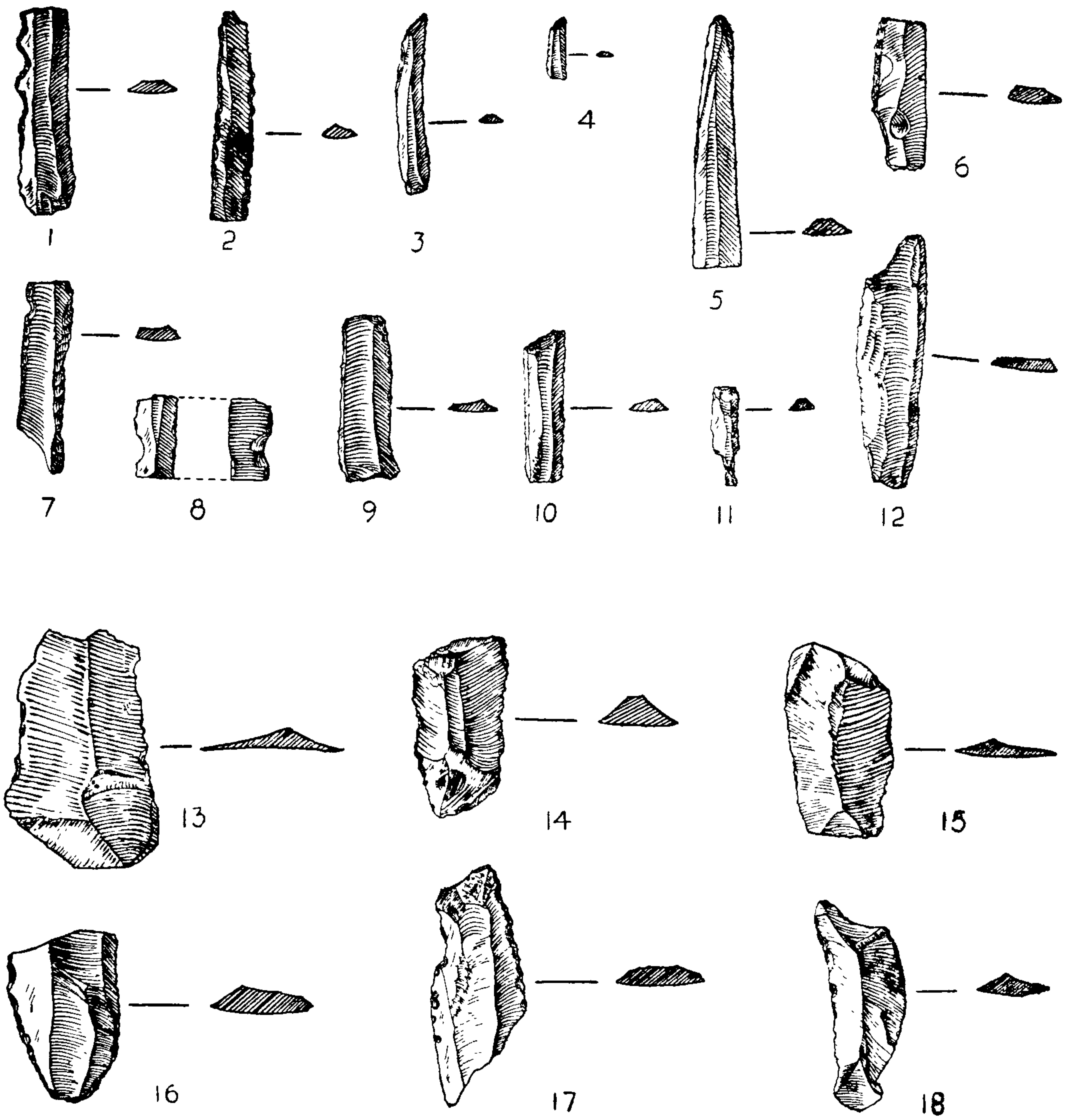


FIG. 123. *Parallel-sided blades, flakes and cores Scale ½*

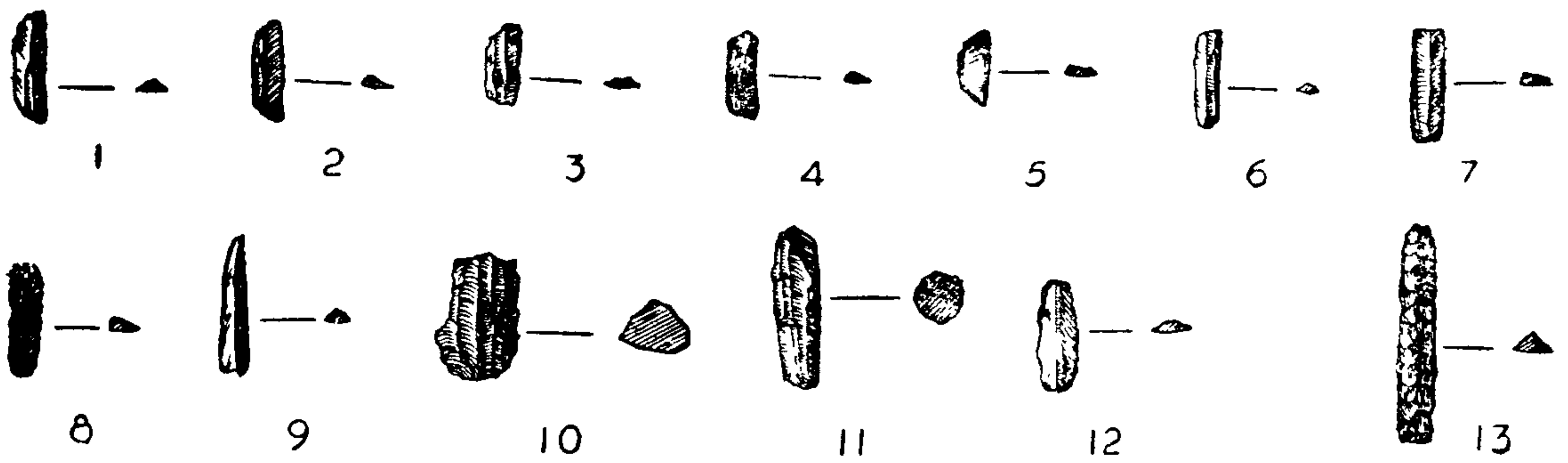


FIG. 124. *Short blades, crescent, fluted cores etc. Scale ½*

12. Chert; yellowish; both margins chipped due to use. Long, broad flake of trapezoid transverse section with oblique flaking at one end showing a secondary trimming, Used as a blade-cum-end-scraper. Platform and bulb visible at the proximal end. Parallel-sided blade. *Type XVI.* From phase IV, PeriodA. (No. 3690).

Assymetrical flakes Pl. CCLV B

13. Chert; greyish; banded, both margins chipped heavily due to use. Broad flake of triangular transverse section with a median ridge. Striking platform and bulb visible at the bulbar end. Assymetrical flake worked into a blade. From phase IV, Period A. (No. 3324).

14. Chert; light pinkish; both working edges chipped due to use. Thick flake of trapezoid transverse section with broken ends. Shining under-surface of one of the margins suggests use as sickle-blade for cutting crops. Assymetrical flake. From phase II, Period A. (No. 8792).

15. Chert; grey; both margins chipped due to use. Bladish flake of flattish transverse section with platform and bulb visible at the bulbar end. Distal end blunted deliberately by rubbing. Signs of rubbing against hard material suggest use as a scraper. Assymetrical flake. From phase II, Period A. (No. 11904a).

16. Chert; yellow; retouched on one margin. Trapezoid transverse section; bulbar platform visible at the proximal end. Assymetrical flake. From phase V, Period B. (No. 2434).

11. Flint; dark brown; margins retouched. Trapezoid transverse section and parallel sides. From phase III, Period A. (No. 7326).

18. Chert; ashy grey; both margins worn out due to use; Flattish triangular transverse section with a low median ridge. Oblique-cut at the distal end producing a point to serve as a scraper. From phase IV, Period A. (No. 5541).

Short blades, crescents, fluted cores etc. Pl. CCLVI A and C

1. Chalcedony; translucent; Fresh-flake-cut on both the longer margins; shorter ones retouched. A short flake of triangular transverse section. Crescent shaped blade slightly retouched at both the curved ends. Short parallel sided blade worked into a crescent. *Type XVIII.* From phase III, Period A. (No. 7353)

2. Jasper; green; chord chipped due to use. A tiny flake of trapezoid transverse section along the arc and the curved ends. Short parallel-sided blade worked into a crescent. *Type XVIII.* From phase V, Period B. (No. 7945).

3. Jasper; green; both the parallel sides almost fresh. A tiny flake of trapezoid transverse section with retouching on shorter sides. No platform or bulb present. Short parallel-sided blade crudely worked into a crescent. *Type XVIII.* From phase V, Period B. (No. 9505).

4. Jasper; dark brown; chord retaining fresh cut. A tiny flake of trapezoid transverse section with minute retouching along the arc and curved ends. Short parallel-sided blade worked into a crescent. *Type XVIII.* From phase III, Period A. (No. 17).

5. Jasper; brown; chord retaining fresh flake-cut arc retouched. A tiny flake of trapezoid transverse section with no platform or bulb. Short parallel-sided blade worked into a crescent. *Type XVIII.* From Phase V, Period B. (No. 8080).

Short-parallel-sided blades (pl. CCLVI A)

6. Chalcedony; translucent; A flake with transverse trapezoid section with one margin steeply retouched and the other closely over three-fourths the length. Diffused bulb slightly visible at one end. Distal end broken. Short parallel-sided blade. *Type XIXa.* From phase V. Period B. (7850).

7. Chalcedony; milky white; Flake with transverse trapezoid section; one margin steeply retouched and the other chipped due to use; diffused bulb faintly visible; Distal end broken. Short parallel-sided blade. *Type XIXa.* Unstratified. Period A. (No. 2360).

8. Jasper; green; both margins retaining primary flake cut. A thin flake of trapezoid transverse section; striking platform and bulb of percussion visible; Broken at the distal end. Short parallel-sided blade. *Type XIXb.* From phase II, Period A. (No. 8880).

9. Chalcedony; transluscent; Both margins retouched. A flake with transverse triangular section and prominent mid-ridge. Both margins converging to a point at one end. one margin steeply retouched and the other closely retouched. Short parallel-sided blade. *Type XX.* From phase II, Period A. (No. 809).

Chisel. Pl. CCLVI B

Agate; brownish; rombhoid; square; chipped and polished. Working edges sloped from both sides. From phase V. Period B. (No. 17443). An important evidence regarding contact with Neolithic folk. Fig. 121, *8.*

Short cores ; Fig. 124, *10-11*

10. Fluted core; jasper; variegated green and brown; fluted on all sides, narrow negative scars indicate the size of the resultant blade. Broken. From phase V, Period B. (No. 3635).

11. Fluted core; jasper; green; conical at one end. Discontinuous fluting indicates breakage of blades while working. From phase II, Period A. (No. 105).

12. Fluted core; jasper; green, conical. Fluted on all sides. Narrow and small parallel negative flake-scars suggesting production of short blades. From phase III, Period A. (No. 364).

Flake with crested ridge Pl. CCLVI-C ; Fig. 124, *13*

13. Flake with crested ridge; Chert; tan brown; median ridge showing retouching in the middle portion of one surface. Fresh flake cut seen on another surface. Narrow triangular transverse section with alternate meticulous flaking indicated by negative scars. Platform and bulb visible. A fine example of crested ridge guiding technique. From phase III, Period A. (No. 4266).

Bowl, dishes etc. Pl. CCLVII A; Fig. 125, *11-13*

1. Amphibole schist, bowl with incurved rim, convex profile and rounded base. Damaged. From phase III, Period A. (No. 15322). Fig. 125, *12*

2. Ossiferous syenite; shallow disk with a flat rim and saggar base. Polished surface; Damaged. Unstratified. Period A. (No. 6875). Fig. 125, *13*

3. Gneiss. Shallow dish with blunted rim and saggar base. Damaged. From phase III, Period A. (No. 15324). Fig. 125, *11*

Stone weights—Cuboids Pl. CCLVII B; fig. 135.

1. Chert, Cuboid, From phase IV Period A (No. 13599). (fig. 125, 3).
2. Chert, Cuboid, Surface find Period A (No. 6050).
3. Chert, Cuboid, From Phase III Period A (No. 12471).
4. Chert, Cuboid, Surface find Period A (No. 1236).
5. Chert, Cuboid, From phase IV Period A (No. 14079).
6. Chert, Cuboid, From phase III Period A (No. 3990).
7. Chert, Cuboid, From phase IV Period A (No. 9170)

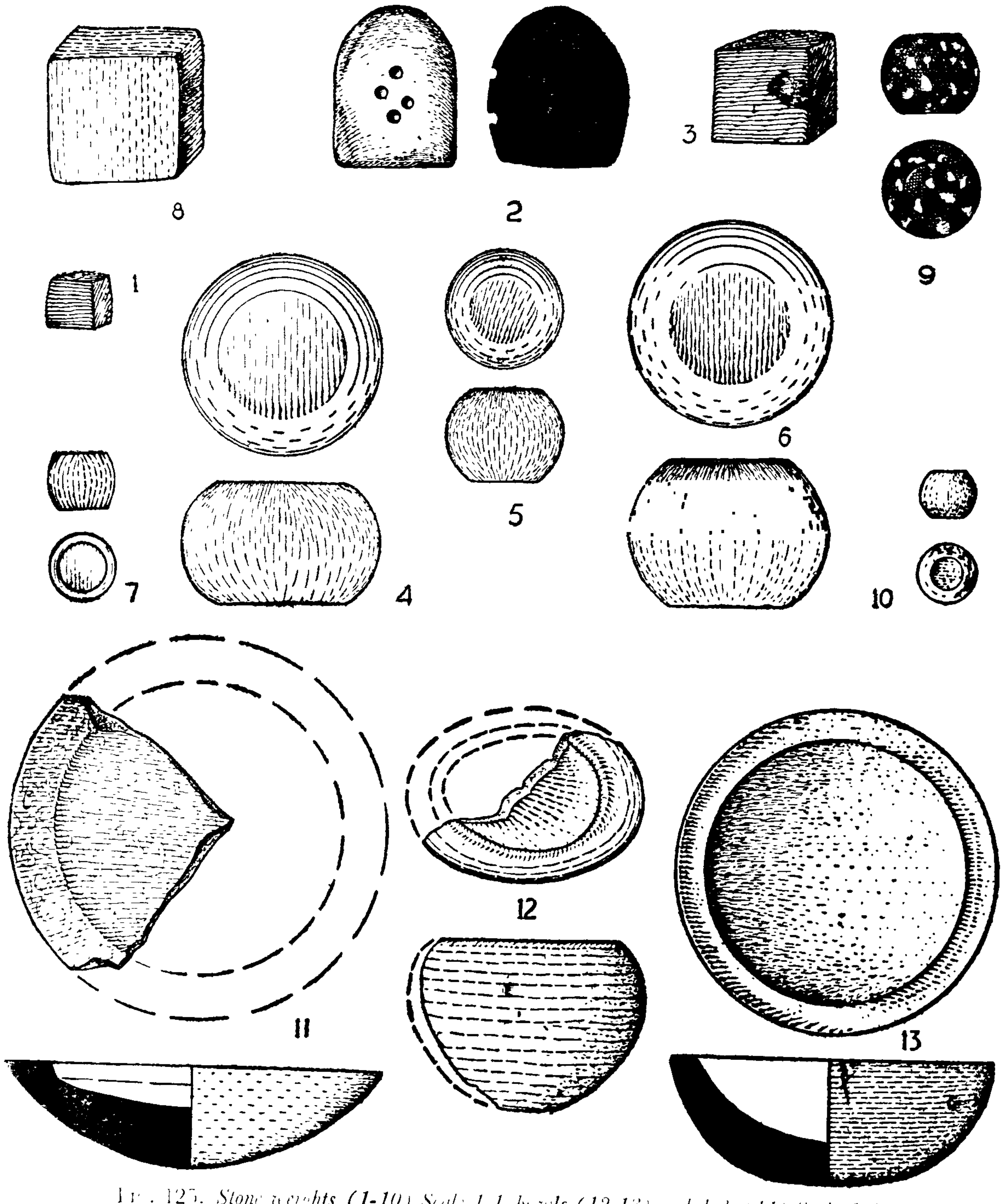


Fig. 125. *Stone weights (1-10) Scale 1/1, bowls (12-13) and dish (11) Scale 1/2*

8. Chert, Cuboid, From phase I Period A (No. 5459).
9. Chert, Cuboid, From Phase III Period A (No. 15332).
10. Chert, Cuboid, Surface find, Period A (No. 12342).
11. Chert, Cuboid, From phase V Period B (No. 9617). (fig. 125, *1*).
12. Chert, Cuboid, From phase IV Period A (No. 5553).
13. Chert, Cuboid, unstratified Period A (No. 6049).
14. Chert, Cuboid, From phase IV Period A. (No. 10748).

Spheroids, Cones etc. Pl. CCLVIII A.

1. Chert; truncated sphere; Period A. (No. 2304). fig. 125, *4*.
2. Sandstone; truncated spheroid. Period A. (No. 2297). fig. 125, *6*.
3. Schist, truncated sphere. Period A. (No. 15302).
4. Granite; truncated sphere, Period A. (No. 15311).
5. Granite; truncated sphere, Period A. (No. 15326).
6. Granite; truncated sphere. Period A. (No. 15306).
7. Agate; truncated sphere; Period A. (No. 15307). Fig. 125, 5.
8. Felspar, truncated sphere; Period..(No. 15308). Fig. 125, *9*.
9. Schist; truncated sphere. Period A. (No. 5800). Fig. 125, *7*.
10. Agate; truncated sphere; Period A. (No. 1098). Fig. 125, *10*.
11. Chalcedony; truncated sphere. Period A. (No. 1099).

Pl. CCLVIII B

1. Schist; cone; Period A. (No. 15319).
2. Banded gneiss; cone; Four blind holes for adjustment of weight; Period A. (No. 15318). Fig. 139, *2*.

Pl. CCLIX A

1. Hornblende felspar; semi-spherical (No. 15273).

Small cones with button-head Pl. CCLIX B

1 to 14. Schist and agate; cones with a flat circular base and groove below the button top. Varying in height from 1/2 in. to 1½ ins.

15. Terracotta—cone without a groove.

Stone Anchor CCLX A ; Fig. 126

1. Sandstone; triangular in plan; almost rectangular section; hole chiselled near the apex from both sides; roughly hewn; From the basin of the dock. Period A. 9 ins. at the base; 4.5 ins. at the apex. 8 ins. thick

2. Sandstone; circular; rectangular section; conical hole in the centre; roughly hewn. From the basin of the dock. Period A. 20 ins. × 18 ins. 17 ins. thick.

3. Miliolite; irregular in plan and section; central hole worked from both sides. Two smaller holes, one at the top and the other near the margin for fixing sticks suggest use of the anchor on sandy as well as rocky beds. Depressions due to use of rope. From the basin of the dock. Period A. 19 ins. × 15 ins. 14 ins. thick.

Pl. CCLX B ; Fig. 126

4. Limestone; anchor ovoid; rectangular, large hole driven from both sides in the centre for ropes and two smaller ones near the central hole and the margin for sticks. Other blind holes natural. Marks of use of rope seen on the margin. From the basin of the dock. Phase III, Period A. 20 ins. 18 ins. 16 ins. thick.

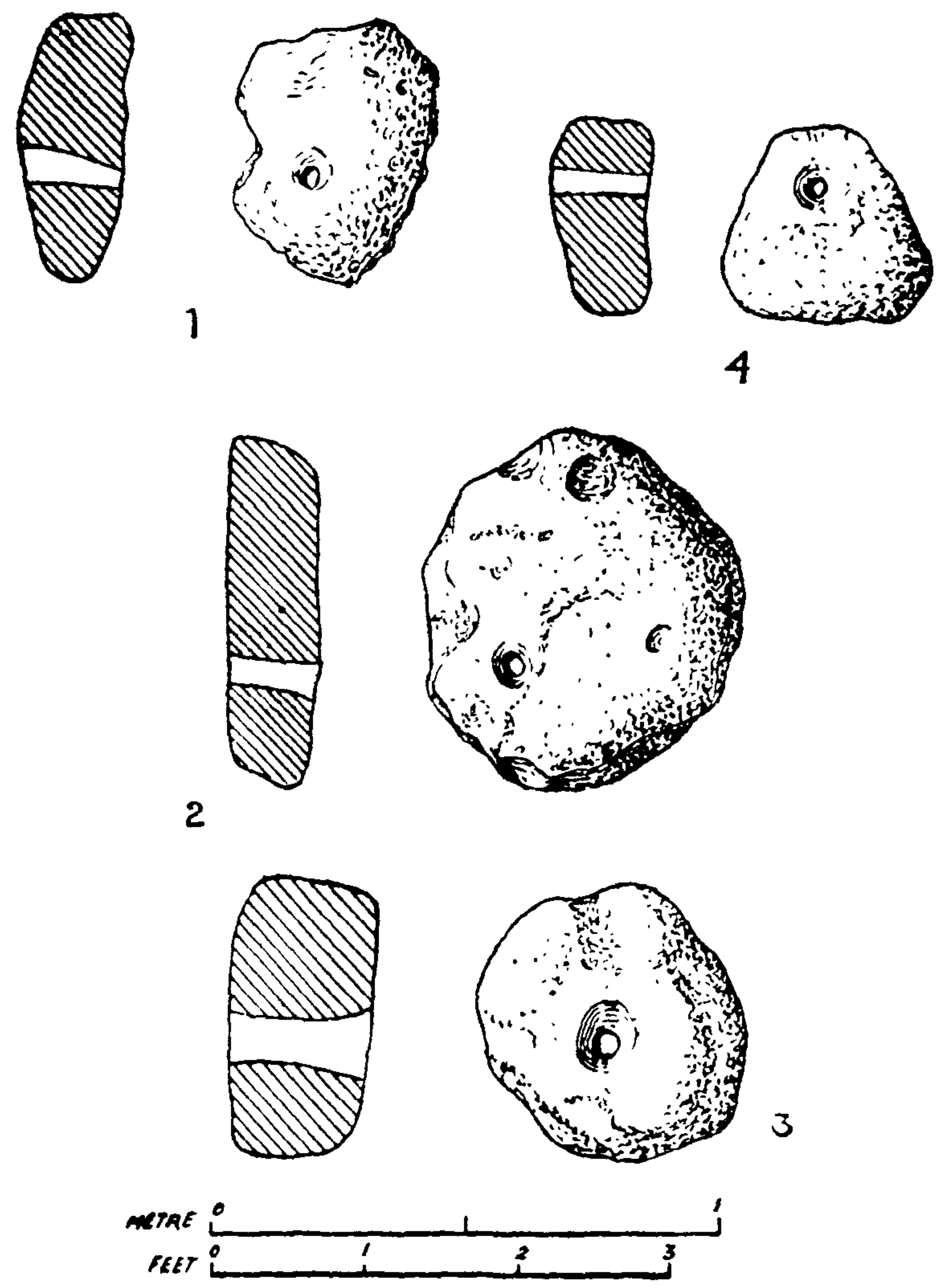


FIG. 126. *Stone Anchors*

Pl. CCLXI A

Miliolite; anchor almost lunate shaped; ovoid section; hole right through near the cord and two blind holes near the arc. *In situ*—near the embankment of the dock; 38 ins. × 36 ins. 22 ins. thick. From Period A.

Tripod stand Pl. CCLXI B

Sandstone; circular with a rectangular section; upper surface smooth and trooved. Undersurface with a floral design; Highly artistic. Three supporting pedestals suggest that the object was used as a seat. From phase V, Period B.

Burnishers, Touchstones etc. Pl. CCLXII A

1. Chert; lunate-shaped; rectangular in section with truncated edges; Burnished. From phase III, Period A.
2. Black schist; lunate-shaped; rectangular section; touchstone. From phase III, Period A.
3. Granite; elliptical; rectangular; Floor-polisher. From phase III, Period A.

Arm of Statue Pl. CCLXII B

Alabaster : A detachable arm of a stone statue, perforated.

CHAPTER XXI

BEADS

1. INTRODUCTION

The Harappans used every conceivable material ranging from baked clay to gem-stone and gold for making beads and pendants. The refined taste and selectivity of the lapidaries of Lothal are explicit from the unique shapes and variegated colours of the beads produced by them in spite of the fact that much of the raw material, especially semi-precious stones, had to be imported from outside. The bead-factories at Lothal produced beads not only for domestic use but also for export.

Among the materials used for making beads mention may be made, in the order of priority, of steatite, faience, semigems such as carnelian, agate, chalcedony, jasper, opal onyx, chrysoprase, lapis lazuli, plasma etc., besides terracotta, copper gold, shell, ivory, and bone. All the stages of manufacture involved in bead-making, namely, heating, chipping, grinding, sawing, polishing and finally boring can be seen from the raw material and half-finished and fully-worked beads found at Lothal (pl. CCLXIII A-B) as in Chanhudaro.

A. HISTORY OF BEAD-MAKING IN GUJARAT.

A bead factory with a working platform in the open courtyard surrounded by eleven rooms has been laid bare in Block E near the acropolis (above p. 118). Two earthen jars one containing 582 carnelian beads and another containing 212 beads of carnelian, shell and steatite were found embedded in the platform. Several cores, flakes, ground and unbored beads were scattered all over the courtyard and in the rooms around. To the north-east of this factory is a kiln used for baking the raw-material and finished product (above p. 118). Another important evidence for suggesting that the mud-brick structure with a working platform surrounded by worker's room was a bead-factory is that a flanged drill-bit of bronze used in boring stone beads was found near the factory.

It is fairly certain that the bead-makers of Lothal imported agate for making carnelian beads from the Rajapipla nines through other Harappan ports such as Bhagatrav and Mehgam (above p. 555). Even now the lapidaries of Cambay import agate and chert from the same area. Very recently new evidence has come to light regarding the supposed trade between the Neolithic folk of the Deccan and South India on the one hand and the Harappans on the other. At Tekkalakota, an important Neolithic settlement in Bellary District of Karnataka, and at Sivavaram in Kurnool district of Andhra, wafer and micro-beads of burnt steatite, characteristic of the Indus Civilization have been found. It is therefore suggested that the Harappans obtained steatite either directly from the Neolithic folk of the Deccan or indirectly through some other agency. Similarly they might have obtained gold from the Hatti mines or the Kolar mines in the neighbourhood of which Neolithic settlements have come to notice.

In return for raw steatite and gold obtained from the Neolithic folk Harappans seem to have given finished beads of burnt steatite and copper tools.

The bead-making industry did not cease with the end of the Indus Civilization in Kathiawar. The ancient site of Nagara identified with Minnagar (Mahinagara) mentioned in the Periplus and situated near Lothal has yielded a large number of carnelian beads,

finished as well as unfinished, along with the Red Polished Ware. The site was occupied in the first century A.D. and later Hieun-Tsang, the Chinese traveller has, in his travel-records, made mention of the bead-exporting trade of Cambay with Egypt and the far-eastern countries. In medieval times too, Cambay was an important bead-making centre as is borne out by the recent find of a jar containing thousands of finished and unfinished carnelian beads along with two inscribed Jaina images of the 12th-13th century A.D.

B. Modern Bead Industry of Cambay

At present bead-making is a flourishing industry at Cambay. Agate and chert are imported from the Ratanpura mines near Rajpipla. Nowadays the raw material is brought by rail but in ancient times it was carried by boats plying between Broach and Cambay. Besides beads, ring-stones and pendants are also made from semigem stones. The finished products are exported mostly to East Africa where they are used as ornaments and for decorating the graves. The modern process involved in making beads of semi-precious stones is as follows:

Nodules of agate (but not chert) are slowly heated in small pots embedded in an earthen furnace or pot-kiln filled with saw dust to soften the cortex (pl. CCLXIV A). These baked nodules, smoky in colour, are then removed and by a process of flaking with a small hammer of stag-horn the cortex is removed. In doing so the nodule is held against a pointed iron bar between the fingers (pl. CCLXIV B). Not much force is used while striking. Thereafter the lump is broken to the required size and the requisite shape is given by gradual controlled flanking (pl. CCLXV A) using pressure-technique. Polishing is done in a rotary drum in which beads and sand are put together (pl. CCLXVB). After polishing boring is done from two ends using two drills hafted on hand-borers. The drill-points are fixed at the centre marked at either end. A fine abrasive and water are used at the working ends of the drills to facilitate boring. Beck says that drills of chert were used at Chanhu-daro.[1] This is highly doubtful. Bronze drills must have been used. Nowdays drills with roughly faceted bits are fixed and the apparatus is worked with a bow. After boring, the beads are heated once again to obtain a deeper colour. Calcium and an oxidising agent such as ferrous oxide, a common ingredient of the soil, are used in this process.

C. Bead Industry of Lothal

The Lothal folk also followed almost the same process as is being adopted by the modern lapidaries. At first nodules of agate were heated to a smoky colour and the cortex was removed. The core was then reduced to the required size and shape by low-flaking using the pressure-technique. Subsequently by rubbing on slabs of sandstone the surface was smothened and the edges were rounded off. Polishing might have been done by using haematite granules or fuller's earth in fine chamois leather, after rolling them over a sandstone block. Sand was used as a smoothening medium. Beads were subsequently bored from both sides using flanged drills of bronze (pl. CCXXXIX B, *3-4*) and finally heated in the kiln referred to above. Perhaps the reference in the clay tablets from Ur to the import of stone beads from Dilmun, Magan and Meluhha may be to the beads from the Indus Valley and Kathiawar. A considerable number of nodules, flakes and worked cores of carnelian, agate and jasper are recovered at Lothal. Among the unfinished beads

[1]Mackay *op. cit.* 1943, p. 210.

some are half-chipped, some half-bored and a few are polished but not bored (pl. CCLXIII B).

Mention has already been made of the bead-maker's factory where nearly eight hundred assorted stone beads were found. The kiln used by the lapidaries for heating beads is ovoid on plan, its longer axis being 5 ft. and height 1 ft. 4 ins. It is not known whether it had a vaulted roof or not. Thin burnt-bricks are used for the walls which are mud-plastered along with the floor. The four interconnected flues in the floor of the upper chamber allowed fire to reach the earthen bowls containing pebbles and beads. A A huge dump of dehydrated lime seen near the kiln (pl. XCI B) proves conclusively that limestone was used for completely dehydrating steatite. Bannister and Canningball have said in the case of the micro-steatite beads from Chanhu-daro that the beads must have been dehydrated and then heated to a temperature 1200°C. Beads of gemstones as well as steatite must have been baked in kiln mentioned above where high temperature could be reached. Lothal is the only Harappan site where evidence of such an elaborate arrangement for large-scale production of beads has been found. Obviously it must have been a very important centre for making beads. In the case of steatite beads the raw material was powdered, made into a paste and rolled into tubes over a thread or wire. These tubes were fired and cut into thin sections with a fine wire or saw to obtain disk (wafer) or cylindrical beads[1]. Marks of cutting with a wire are clearly visible on the disk beads from Lothal (pl. CCLXIX A). Thicker beads of steatite appear to have been produced by heating raw steatite pieces which were cut to the required size and shape while the barrel-shaped ones bearing trefoil design (pl. CCLXVII) must have been moulded or stamped.

The lapidaries of Lothal used very delicate instruments with effective control in fashioning micro-beads of gold (pl. CCXCVI A) of uniform size with a diameter of less than 1/50th of an inch. Great skill has been exhibited by them in covering a small jasper bead with a gold cap on either margin. In the selection of the raw material and the shaping of the beads to bring out prominently the variegated bands in agate, carnelian, chert and jasper they are unequelled by the lapidaries elsewhere. The eye-bead (fig. 130, *2*) and boot-shaped beads (fig. 130, *6*) are good examples of the expert technical knowledge the Lothal people had in selecting material and shaping them into attractive forms. Gold foils are also found to have been skillfully joined to produce pendants with axial holes.

According to Beck etching is done by the application of an alkali such as sodium hydroxide or the alkaline juice of a herb by which a desired pattern is drawn over the bead and heated to a required high temperature until the alkali enters the stone and leaves a permanent impression. There are some agate beads in the centre of which one or two circular patches are seen. They are called 'eye-beads'. In these cases it is found that when the co-efficient of expansion of the material is altered by heating, the upper layer flakes off owing to the strain caused by the continual change in temperature. Beads of this type (pl. LXIX c, 2, *6*) have been mistaken for inlaid ones. Concentric circles, drawn in the form of figure '8' or in three contiguous groups were popular in the case of standard bicone carnelian beads. Beck opines that the technique of etching was transmitted by the Indus Valley folk to their contemporaries elsewhere. What is more likely is that beads were etched at one particular centre and exported to all others. In view of the fact that Lothal has yielded the largest number of etched beads and that it manufactured carnelian beads on a very large scale its claim for being the first centre wherefrom the technique of etching travelled to other centres should be considered.

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[1]For alternate method suggested by Hegde see *Harappan Civilization* (ed). G. L. Possehl.

2. MATERIAL

A. Steatite

Steatite, a soft massive variety of talc, was the most popular raw material used in the bead industry at Lothal. It is composed of hydrous magnesium silicate H_2O_3 NGO4 Sio_2. The present source of steatite are Devni Mori (23°40′N—73°26′E) and Kundol (23°39′N—73°38′ E) in the former Idar state in North Gujarat. The outcrop is more than a mile long and 200 ft. wide at the latter site. This variety is free from impurities and pale green in colour. But there is no evidence to show that this source was worked by Harappans. However, the sources of black and yellow varieties of steatite are far away in the Deccan especially in Mysore State. Recently, steatite deposit is reported from *Lokhan* and *Mora,* both situated in North Gujarat, which were not worked in Harappan times. The extensive use of steatite at Lothal suggests that there was a regular inflow of the raw material. Most of the steatite beads are made of paste and a few are of stone.

The micro-cylinder beads (fig. 128, *13*) of steatite paste were manufactured by rolling the paste on a thin wire or thread and fired to as high a temperature as 1200°c., thus rendering them unbreakable. Thousands of micro-beads were found in an earthen jar in a house in the Acropolis. The average length of the beads is not more than 1/32 inch. The extreme hardness and unequalled precision achieved in making these beads are remarkable. Mirco-beads are recorded in the Royal Tomb at Ur. Obviously they must have been imported from India.

Another important type in steatite is the disc-bead, also called the 'wafer' bead by Mackay. The process of manufacture of dise-beads has been referred to earlier (above p. 582). Among other interesting types is a standard barrel with a trefoil design (pl. CCLXVII, *7*). There is another bead with lenticular section which is coloured pink. The trefoil pattern, also noticed in the Sargonid levels of Brak, etc. has a mythological significance. Similar beads occur at Harappa[1] and Mohenjo-daro.[2] A standard spherical ridged bead (Fig. 132, *6*) from Lothal can be compared with the one in faience from Harappa.[3] A short disk lenticular bead with two perforations was used as a spacer (Fig. 128, *17*) at Lothal. This type does not occur in the Indus Valley.

Steatite seals and beads are covered by a thin film which is considered by some as a glaze (above p. 582). The only evidence of painting beads is afforded by a faience bead (fig. 129, *3*) the paint used being ferric oxide.

B. Faience

Faience is a synthetic product, being calcined quartz formed by the amalgamation of lime with quartz at a very high temperature. If the fusing is not done under the required temperature and condition, it has a tendency to crumble when handled, but a perfect specimen is stone-hard. The glaze frequently noticed on the surface of faience objects is due to silica, a natural mineral ingredient of quartz. Lothal has yielded some of the hardest faience beads including a few talco-faience ones with a light blue tint.

Segmented beads strictly confined to faience are of particular interest as they provide collateral evidence for dating and cultural contact between Lothal and Western Asiatic sites such as Ur. Childe[4] considers this type as an important cultural link between the main

[1]Vats *op. cit.* II, 1940, pl. CXXIII-55.
[2]Marshall *op. cit.* III, 1931 pl. CLII-17.
[3]Vats, *op. cit.* pl. CXXVIII, No. 10.
[4]Childe *op. cit.* 1958 p. 139 ff.

centres of the Indus Valley and Mesopotamian civilizations. The maximum number of segments on beads found at Lothal is six (Fig. 129, *10*) while two or three segments are more common. The intermediate grooves are not as deep on Lothal beads as on the beads from Mohenjo-daro. Disk type is unknown in faience. The short truncated bicone bead (Fig. 129, *14*) is decidedly a rare type at Lothal and other Harappan sites. But an identical type in faience has been reported from the Royal Tombs at Ur. Hargreaves mentions that such beads are found at Nal in Baluchistan. Standard spherical and circular tabloid beads are rare in faience, while short cylinder circular ones are common.

C. Terracotta

Terracotta beads are the cheapest to produce and were therefore used mostly by the poor at Lothal. The plasticity of the material helps in copying any type of ornament produced in other materials. Finely levigated clay has been used for making beads, which were moulded or modelled and treated with slips and colours. they were fired carefully in closed ovens where heat was regulated. Sometimes beads were also made by rolling lumps of clay on fibre or reed which was burnt out when baked.

Barrels, cylindricals and short biconicals are common types of beads in terracotta. Spacers and 'D' type end-beads resembling those in gold and copper are also occasionally noticed. The maximum number of perforations in a spacer is six and the minimum is two as was the case in the Indus Valley also. Spacers in gold have four to ten holes while those in copper have two to six. Among the rare types mention may be made of a standard-spherical, gadrooned bead (Fig. 127, *6*). No segmented bead is found in terracotta at Lothal, while one was found at Harappa.

It is interesting to note that beads of terracotta and jasper were more popular in Period B than in Period A, because precious metals, semi-precious stones and even steatite could not be imported into Lothal in Period B. This may be due to the decline in the overseas trade as a result of the catastrophic floods in phase IV. A similar change-over to jasper and terracotta, both available locally, is noticed in Rangpur IIc and III. Short truncated convex-cone and short-bicone (Fig. 127, *26* & *29*) are common types in terracotta in Lothal B.

D. Shell

Chank-shell was also used for making beads, inlays, gamesmen, bangles etc., Kathiawar coast is an important source for this material and chank-fishing must have been a flourishing industry in Bet Dwarka. Beads of dentalium, a fresh-water shell, were also popular with the Kathiawar-Harappans. By truncating the two tips of dentalium a tapering ridged bead (Fig. 129, *24*) was produced. This type came into great use in Period B. Standard-cylinder was a popular type of bead in chank in the Indus Valley and Kathiawar. Among other types mention may be made of standard or short bicones and barrels, long cylinders, truncated convex bicones and disks.

E. Ivory

Ivory has been springly used for making beads at Lothal, as was the case in all the Indus Valley sites. A standard barrel bead with criss-cross incised grooves is an interesting type (pl. 129, *30*). A similar one is reported from Harappa also.[1] Ivory must have been used mostly for making inlay and gamesmen for export to Mesopotamian towns.

[1]Vats, *op. cit.* II. p. 408. ff.

F. Bone

Bone was used for making awls and pins and rarely for making beads. It appears that the vertebrae of fish were also used as beads of which only a few specimens have been recorded at Lothal, but more at Rangpur. They form biconcave-circular beads.

G. Semi-gemstones

Lapis lazuli, agate, carnelian, jasper, opal, chrysoprase, onyx, cairngorm, bloodstone, plasma, chalcedony, amethyst, crystal and amazonstone (microline feldspar) are some of the varieties of gems and semi-gemstones used for bead-making at Lothal Pl. CCLXXV

Agate :—Agate is banded chalcedony and under this head are included opal, crystal, onyx and milky quartz, which are only different names for differently coloured banded chalcedony. Constitutionally, these are crypto-crystalline silica. Onyx is identified as such from the parallel bands of the same or different hues. It is difficult to work on agate as its texture is complex but, if properly handled, some of the most attractive types can be produced in agate. To quote an example, a unique double-eye bead resembling a cat's eye, is prepared out of a selected agate nodule with 'Zones' of chalcedony (Fig. 130,*6*). 'Zones' are a natural intrusion of a foreign material in the process of solidification of the rock. Normally they are circular in shape. The bead-makers at Lothal were so well-versed in their art that they have given a plano-convex shape to some beads in order to emphasize the 'Zones'. They are known as 'eye-beads' and are very rare in the Indus Valley. It is suggested by some scholars that 'eye-beads' were prepared by inlaying one stone in another and fixing with the help of some resinous medium under certain pressure, but the Lothal specimens are not a case of inlay.

A common type among agate beads is the standard-barrel lenticular (Fig. 130, *3*). In some cases the circular sections are flattened, resulting in an elliptical section. Agate takes a very high polish. It is likely that the well-polished but unbored bead-like objects found at Lothal were used as ring-stones.

The Rajpipla agate-bearing conglomerate and gravels, probably of miocene age, contain rich crypto-crystalline varieties of silica which were imported by the lapidaries of Lothal through Bhagatrav. Other sources are Rangpur (22°2′ N—71°46′ E) in Dhandhuka taluka of Ahmadabad District and Kapadvanj (23°2′ N—73°8′ E) in Kaira District. The bed of Majam river between Mandwa and Amiliyara (23°13′ N—73°6′ E) in Kaira District and the beds of the Bhadar river at Rangpur and Devaliyo in Kathiawar yield small pebbles of crypto-crystalline variety which could be made use of for making small beads. But the varieties used by the Lothal folk are different. The most important types in agate are the standard barrel with a lenticular section, convex cone with a plano-convex section (eye-beads), the cylinder and the 'boot-shaped' ones.

Carnelian Pl. CCLXXIV :—Among semi-precious stones carnelian was the most popular not only because of its attractive red colour and translucency but also because of the plentiful supply of the material from overseas sources. A great variety of beads with various shapes and shades of colour in red, lemon, yellow and a translucent variety known as sard have bene found at Lothal in carnelian. The lapidaries of Lothal produced carnelian by cooking agate. It is a great technological advance over others in bead-making. They knew that for easy working it was necessary to heat the agate nodules. The deep red colour of the beads was due to cooking the finished bead once again in the kiln at a high temperature. Sources of agate have been mentioned above. Long barrels, cylinders, truncated convex-cones, standard bicones with a cylinder section, diamond-shaped ones and small

Table XXI

3. *Quantitative break-up of Beads from Lothal (Materialwise)*

Sl. No.	Nomenclature of material	Period 'A'	Period 'B'	Total	Remarks
1.	Gold	21	3	24	Excluding 500 microbeads.
2.	Copper	93	4	97	
3.	Steatite	501548	419	501967	Including micro-beads.
4.	Black Steatite	1	—	1	
5.	Faience	711	107	818	
6.	Agate	38	3	41	Double eye-bead included
7.	Amazon Stone (Moon stone)	21	—	21	
8.	Carnelian	1200	42	1242	Etched beads included
9.	Cairngorm	1	—	1	
10.	Chalcedony	5	—	5	
11.	Crystal	3	—3	6	
12.	Chert	1	—	1	
13.	Chrysoprase	1	—	1	
14.	Bloodstone	2	1	3	
15.	Granite	—	3	3	
16.	Jasper	18	33	51	
17.	Soapstone	7	—	7	
18.	Lapis Lazuli	3	—	3	
19.	Milky Quartz	5	—	5	
20.	Opal	5	—	5	
21.	Onyx	31	—	31	
22.	Plasma	1	—	1	
23.	Rose Quartz	2	—	2	
24.	Sard	3	—	3	
25.	Terracotta	252	215	467	
26.	Shell	115	111	226	
27.	Bone	—	3	3	
28.	Ivory	1	—	1	

Table XXII

Material and type-wise break-up of beads from Lothal

Material	Type and sub-type		Period A	Period B
CARNELIAN		(a) Etched	12	—
	STANDARD	(a) Bicone	26	—
		(b) Lenticular	4	—
		(c) Cylinder	45	—
		(d) Barrel	307	—
	SHORT	(e) Barrel	102	11
		(f) Truncated convex cone	140	—
		(g) Cylinder	120	—
		(h) Spherical	1	—
		(i) Barrel 'Vase' type	2	—
		(j) Truncated convex bicone	80	—
	DISK	(k) Barrel	269	12
		(l) Convex Cone	10	—
		(m) Bicone	65	—
		(n) Cylinder	2	10
		(o) Oblate	2	1
	LONG	(p) Cylinder	13	—
	STANDARD	(a) Bicone	9	—
		(b) Spherical	17	15
		(c) Spacer-rectangular	11	3
		(d) Truncated convex cone	11	45
		(e) Spacer-ellipsoid	1	3

TABLE XXII *Continued*

Material	Type and sub-type			Period A	Period B
TERRACOTTA	SHORT	(f)	Barrel	32	12
		(g)	Cylinder	20	15
		(h)	Truncated convex cone	11	14
		(i)	Spacer	2	1
		(j)	Convex bicone	17	5
		(k)	Semi-circular	4	—
	DISC	(l)	Convex Bicone	26	21
		(m)	Turncated bicone	10	25
	LONG	(n)	Cylinder	20	30
		(o)	Barrel	39	21
		(p)	Truncated cone	20	15
		(q)	Spacer	2	—
Material	**Type and sub-type**			**Period A**	**Period B**
AGATE	STANDARD	(a)	Cylinder	11	—
		(b)	Barrel	3	—
	SHORT	(c)	Truncated convex bicone	5	—
		(d)	Barrel	3	—
		(f)	Cylinder	10	3
		(g)	'Eye bead'	2	—
CHALCEDONY	SHORT	(a)	Truncated convex cone	3	—
		(b)	Spherical	2	—
PLASMA	STANDARD		Cylinder	1	—
CAIRNGORM	STANDARD		Cylinder	1	—
CHRYSOPRASE	SHORT		Truncated convex cone	1	—

TABLE XXII *Continued*

Material	Type	Sub-type	Period A	Period B
ROSE QUARTZ	STANDARD	Barrel	1	—
CHERT	SHORT	Chamfered Cylinder	1	—
OPAL	SHORT	Barrel	5	—
GRANITE	STARDARD	Cylinder	3	—
MILKY QUARTZ	STANDARD	Barrel	5	—
AMAZONESTONE	STANDARD	(a) Barrel	3	—
		(b) Truncated convex cone	8	—
	SHORT	(a) Cylinder	5	—
		(d) Barrel	4	—
		(e) Truncated convex cone	1	—
BLOOD-STONE	STANDARD	(a) Barrel	1	—
ONYX	STANDARD	(a) Cylinder	5	—
		(b) Truncated convex cone	6	—
		(c) Convex cone	2	—
		(d) Barrel	4	—
	SHORT	(e) Barrel	5	—
		(f) Truncated convex cone	5	—
		(g) Cylinder	4	—
GOLD	STANDARD	(a) Cylinder	1	—
		(b) Spacer	3	—

Table XXII *Cotinved*

Material	Type and sub-Type		Period A	Period B
GOLD	SHORT	(c) Barrel lenticular	1	—
		(d) Barrel circular	2	—
	DISC	(e) Oblate	4	—
		(f) Cylinder	4	2
		(g) Barrel	2	1
		(h) Convex bicone	3	1
		(i) Circular with axial tube	1	—
STEATITE	STANDARD	(a) Truncated convex cone	17	—
		(b) Barrel	40	7
		(c) Cylinder	590	175
	SHORT	(d) Truncated convex bicone	23	3
		(e) Cylinder	410	125
		(f) Spherical	17	—
		(g) Cylinder (Micro)	500000	5000
	DISK	(h) Cylinder (wafer)	353	71
		(i) Bicone	13	—
		(j) Cylinder (Medium)	60	33
		(k) Lenticular	11	—
		(l) Circular	13	5
	LONG	(m) Cylinder	1	—
LAPIS LAZULI	SHORT	Cylinder	3	—

Table XXII *Continued*

Material	Type and sub-type			Period A	Period B
FAIENCE	STANDARD	(a)	Truncated convex bicone	44	9
		(b)	Barrel	155	11
		(c)	Truncated convex cone	81	10
		(d)	Barrel elliptical	18	—
		(e)	Spherical	2	—
		(f)	Circular-tabloid	3	—
		(g)	Cylinder	207	31
		(h)	Cylinder segmented	2	—
	SHORT	(i)	Truncated bicone	23	7
		(j)	Cylinder	110	30
		(k)	Truncated convex cone	37	4
		(l)	Spherical	7	2
		(m)	Cylinder-segmented	3	—
	DISK	(n)	Cylinder	19	3
SHELL	STANDARD	(a)	Cylinder	35	21
		(b)	Barrel	37	29
	LONG	(c)	Cylinder	3	—
	SHORT	(d)	Barrel	23	30
		(e)	Truncated convex cone	5	10
	DISK	(f)	Convex bicone	5	8
		(g)	Cylinder	9	12
		(h)	Truncated convex cone	1	1
IVORY	STANDARD		Barrel gadrooned	1	—

Table XXII *continued*

Material	Type and sub-type			Period A	Period B
	STAND-ARD	(a)	Circular, tabloid	1	—
J		(b)	Barrel	8	2
A		(c)	Truncated convex cone	2	—
S	S H	(d)	Cylinder	6	8
P	O	(e)	Barrel	—	1
E	R	(f)	Truncated convex bicone	—	2
R	T	(g)	Plano convex (Etched)	1	—

Terracotta. Fig. 127; pl. CCLXVI

1. Short oblate, circular, worn out surface. From phase IV, Period A. (No. 2165).
2. Short bicone, circular, Highly weathered. From phase IV, Period A. (No. 8811).
3. Standard truncated convex bicone, circular. From phase III, Period A. (No. 8448).
4. Short convex bicone, circular. From phase II. Period A. (No. 5770).
5. Short semi-circular tabloid, with axial perforation. 'D' type end-bead. From phase II, Period A. (No. 5970). Occurs in gold also.
6. Standard spherical, circular. Decorated with 'nail tip' incisions. From phase III, Period A. (No. 5881).
7. Standard bicone, circular. Incised along the periphery of the perforation. From phase V, Period B. (No. 14400).
8. Short cylinder, circular. Traces of a red slip visible. From phase III, Period A. (No. 890).
9. Standard spacer; rectangular on plan and section; three perforations at irregular intervals. From phase II, Period A. (No. 9381).
10. Standard spacer, rectangular on plan and section; three perforations. Damaged. Roughly modelled. From phase IV, Period A. (No. 14446).
11. Standard tubular, bead-cum-drop-pendant. Roughly modelled. From phase IV, Period A. (No. 5022).
12. Standard spacer, rectangular, cylinder with convex top. Two axial perforations visible. Damaged. From phase IV, Period A. (No. 3072).
13. Standard truncated convex-cone, circular. Surface weathered. From phase IV, Period A. (No. 7629).
14. Long cylinder, circular. Pin-hole perforation incomplete from both ends. Slightly raised edge at one end. From phase III, Period A. (No. 10351).
15. Long truncated cone, circular. Damaged. Surface weathered. From phase III, Period A. (No. 11765).
16. Long truncated cone, circular. Damaged. From phase III, Period A. (No. 6875).
17. Standard spacer, rectangular, cylinder. Two perforations visible. Damaged. From phase I, Period A. (No. 8346).

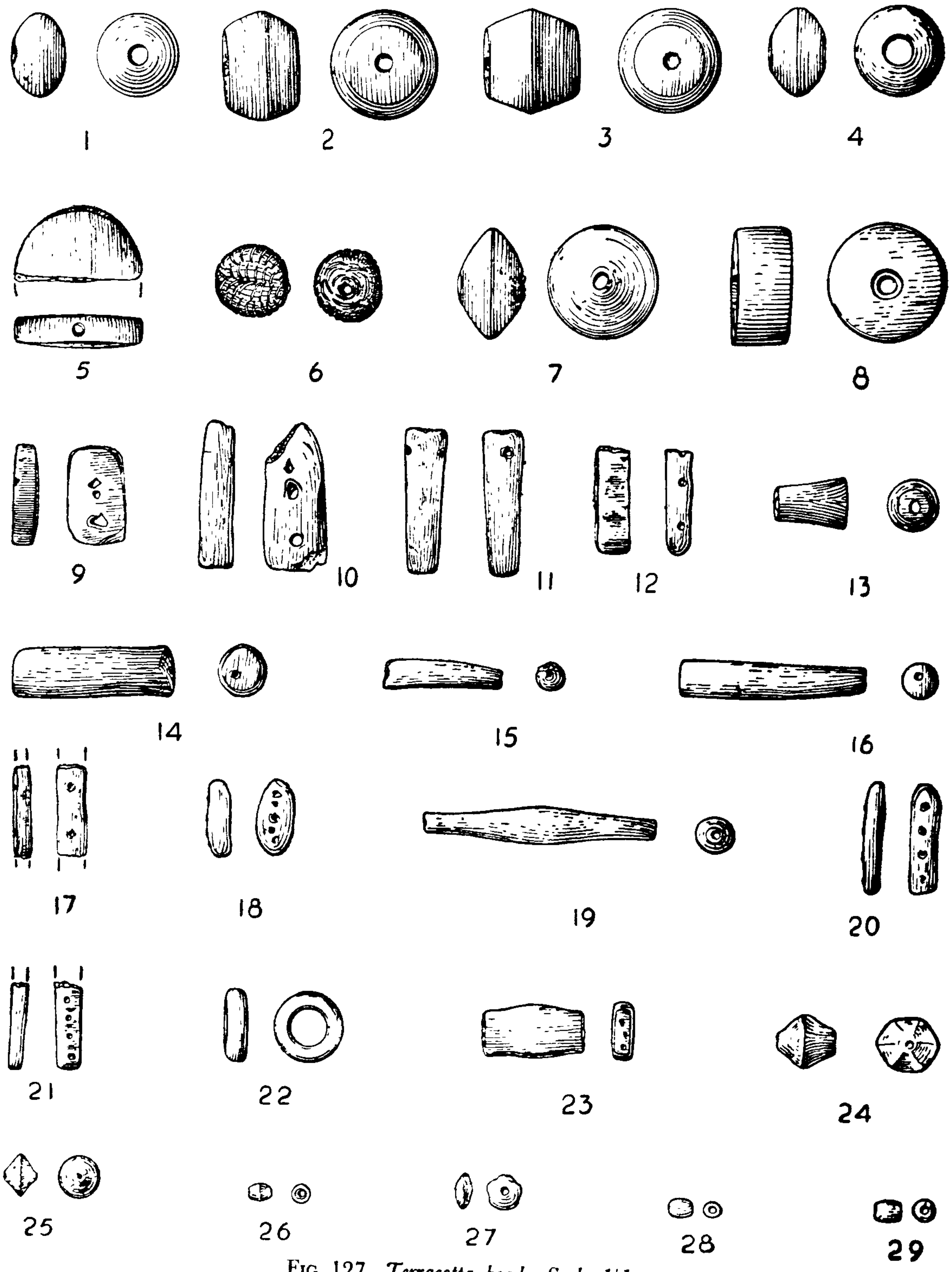

FIG. 127. *Terracotta beads, Scale 1/1*

18. Short spacer, ellipsoid, elliptical. Perforations neither uniform nor in straight line. From phase II, Period A. (No. 830).
19. Long barrel, circular. Traces of red slip visible. From phase IV, Period A. (No. 12107).
20. Standard spacer, cylinder, rectangular, with convex top. Four perforations. From phase III, Period A. (No. 5458).
21. Standard spacer, cylinder, rectangular. Four perforations. Damaged. From phase II, Period A. (No. 11715).
22. Short barrel, circular. Surface weathered. From phase III, Period A. (No. 11445).
23. Standard spacer, flat barrel and rectangular. Three assymetrical perforations. From phase IV, Period A. (No. 11607).
24. Short truncated bicone, hexagon. Ill-fired. Green paint flanked off. From phase I, Period A. (No. 757).
25. Disk bicone, circular. Buff--slipped. From phase III, Period A. (No. 5497).
26. Short truncated convex-cone, circular. Fine red slip. From phase IV, Period A. (No. 13944).
27. Convex bicone, disk. Edges irregular due to breakage. From phase III, Period A. (No. 3083).
28. Short, cylinder, Circular. Fine red slip. From phase V, Period B. (No. 1394a).
29. Short barrel, circular. Fine red slip. From phase V, Period B. (No 1349b).

Steatite. Fig. 128, pl. CCLXVII

1. White; standard barrel, circular. From phase III, Period A. (No. 2588).
2. Greenish white, bicone, disk, circular. From phase II, Period A. (No. 2389).
3. White. disk cylinder, circular. From phase IV, Period A. (No. 5228.
4. Chalky white, standard barrel, semi-circular. From phase IV, Period A. (No. 14126).
5. Chalky white, large disk cylinder, circular. From phase III, Period A. (No. 8880).
6. White. short spherical, circular with radiating grooves. From phase II, Period A. (No. 2743).
7. White, standard barrel and circular, carved with trefoil design, unique. From phase III, Period A. (No. 8446).
8. White, cylinder, circular (disk), From phase I, Period A. (No. 3341). Occurs in gold also.
9. Yellowish white, cylinder, circular (disk) bead. From phase III, Period A. (No. 11019).
10. White; medium thickness, cylinder, circular (disk). From phase II, Period A. (No. 8471).
11. White, bicone, circular (disk). From phase I, Period A. (No. 2819).
12. Dirty white, cylinder, circular (disk). From phase V, Period B. (No. 3090).
13, standard cylinder, circular. From phase IV, Period A. (No. 11799).
14. Whitish green, standard truncated convex-cone, circular. Weathered. From phase V, Period B. (No. 14253).
15. Yellowish, short, cylinder, circular. Weathered. From phase III, Period A. (No. 2701).
16. Black, long, cylinder, circular. From phase II, Period A. (No. 2654).
17. White, disk lenticular, tabloid with two perforations. A unique spacer. From phase III, Period A. (No. 8836).
18. Chalky white, truncated convex-cone, circular (disk), From phase V, Period B. (No. 14386).
19. White, cylinder, circular (disk). From phase V, Period B. (No. 12097).
20. White, cylinder, circular (disk). Marks of cutting with a fine saw or wire visible. From phase IV, Period A. (No. 6411).
21. White, short truncated convex-bicone, circular. From phase V, period B. (No. 11154).
22. White, cylinder, circular (disk). From phase IV, Period A. (No. 393).
23. White, disk circular, tabloid with axial perforation. From phase IV, Period A. (No. 3090).
24. Greasy white, short, truncated, bicone and circular. From phase III, Period A. (No. 9378).

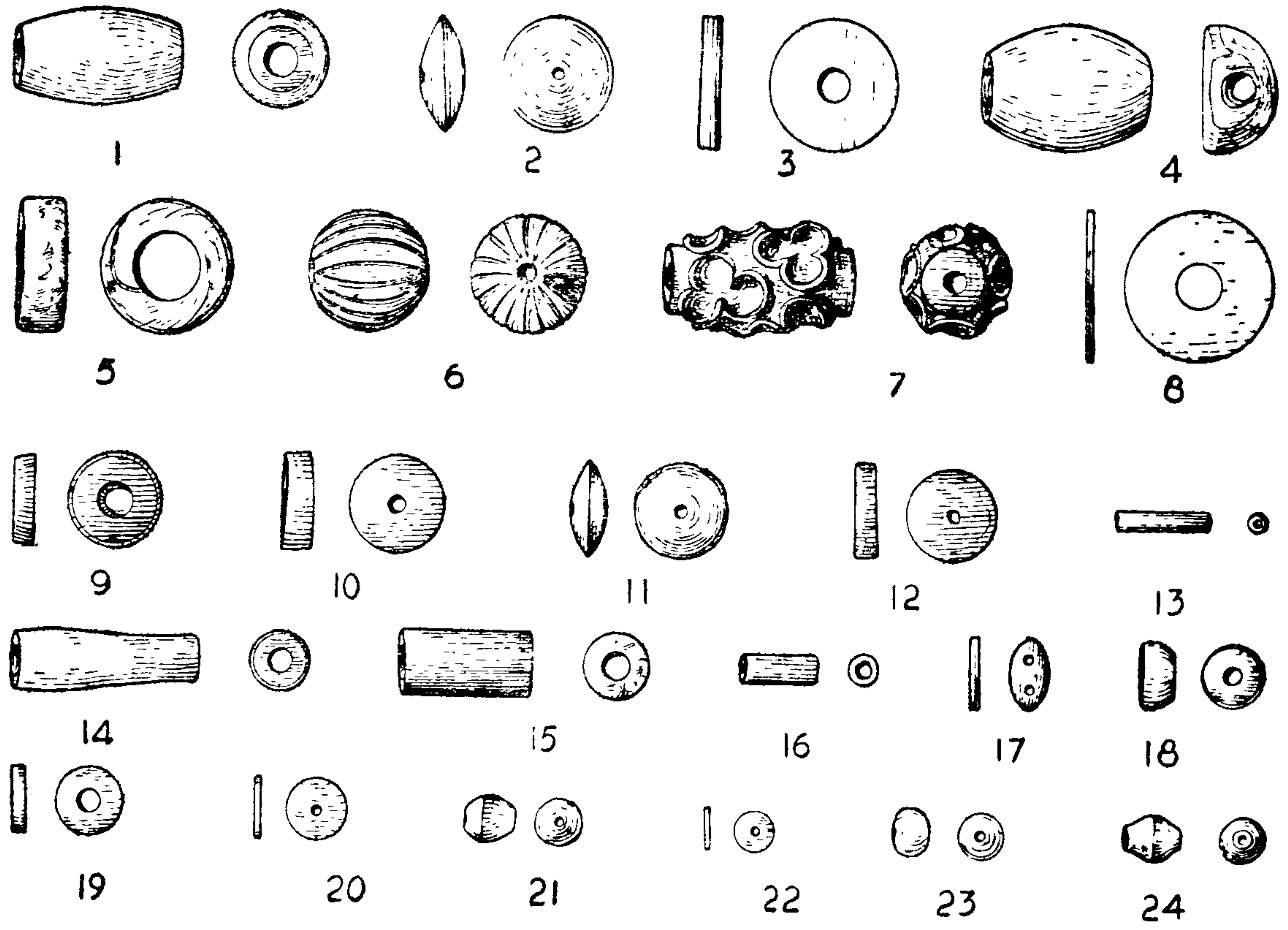

FIG. 128. *Steatite beads, Scale 1/1 (1-8) ; Scale 2/1 (9-24)*

Faience and shell. Fig. 129; Pl. CCLXVIII

1. Green, standard truncated convex bicone, lenticular. From phase III, Period A. (No. 1256).
2. Light green, standard barrel, circular. From phase II, Period A. (No. 2566). Occurs in steatite also.
3. Green, standard truncated convex-cone, circular. Discolourized. From phase III, Period A. (No. 7383).
4. Bluish white; standard barrel, elliptical. From phase IV, Period A. (No. 3325).
5. Green, short truncated bicone, circular. From phase V, Period B. (No. 14183).
6. Green; standard circular tabloid with axial perforation. From phase IV, Period A. (No. 238). Occurs in jasper also.
7. Green, standard spherical circular. From phase III, Period A. (No. 8470).
8. Green, disk cylinder, circular. From phase IV, Period A. (No. 1305).
9. Green, standard cylinder, circular. From phase IV, Period A. (No. 2654).
10. Green, segmented standard cylinder, circular. Six segments visible. From phase II, Period A. (No. 1729).
11. Green, short cylinder, circular. From phase III, Period A. (No. 6825).
12. Green, standard cylinder, circular. From phase IV, Period A. (No. 12302).
13. Pale green, short cylinder, lenticular. From phase IV, Period A. (No. 6716).
14. Green, short truncated bicone, circular. From phase IV, Period A. (No. 3591).
15. Green, short truncated convex-cone, circular. From phase V, Period B. (No. 1208).
16. Green, segmented short cylinder, circular. Only two segments visible. From phase IV, Period A. (No. 6230).
17. Green, short spherical, circular. From phase II, Period A. (No. 1607).

Shell

18. White, short truncated convex-cone, circular. From phase IV, Period A. (No. 11940b).
19. Milky white, long cylinder, circular. From phase II, Period A. (No. 1254).
20. White, standard barrel, circular. From phase IV, Period A. (No. 11941).
21; Buff, convex-truncated bicone, circular (disk). From phase V, Period B. (No. 11171).
22. Yellow convex bicone, circular (disk). From phase III, Period A. (No. 5993).
23. White, short barrel, rectangular. From phase III, Period A. (No. 6916).
24. White, corrugated almost cylindrical circular slightly curved and tapering. Dentilium. From phase V, Period. (No. 10982).
25. Brown, long cylinder, circular (disk). From phase III, Period A. (No. 7784). Occurs in gold and steatite also.
26. White, cylinder, circular (disk), From phase V, Period B. (No. 10673).
27. White, cylinder, circular (disk). From phase IV, Period A. (No. 11801).
28. White short truncated convex-bicone, circular. From phase V, Period B. (No. 10569).
29. White, short cylinder, circular. From phase IV, Period A. (No. 7892).
30. Ivory white, standard barrel circular. Gadrooned. From phase IV, Period A. (No. 1194).

Steatite pl. CCLXIXA

Steatite disk bead with wire warks

Agate. Fig. 130, pl. CCLXIX B

1. Brown and white. Short truncated convex bicone, elliptical. Moss agate. From phase III, A. (No. 9050).

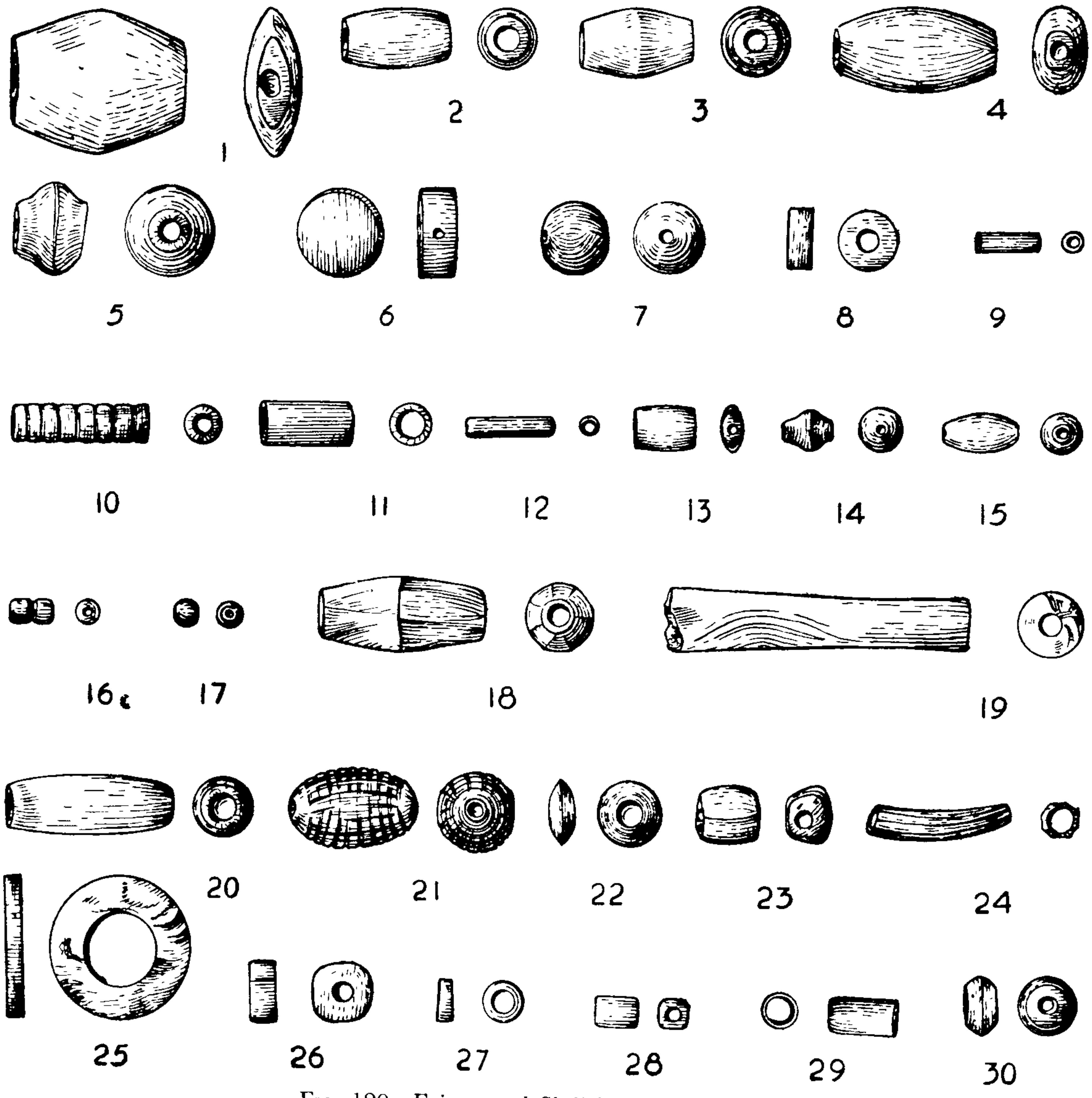

FIG. 129. *Faience and Shell beads, Scale 1/1*

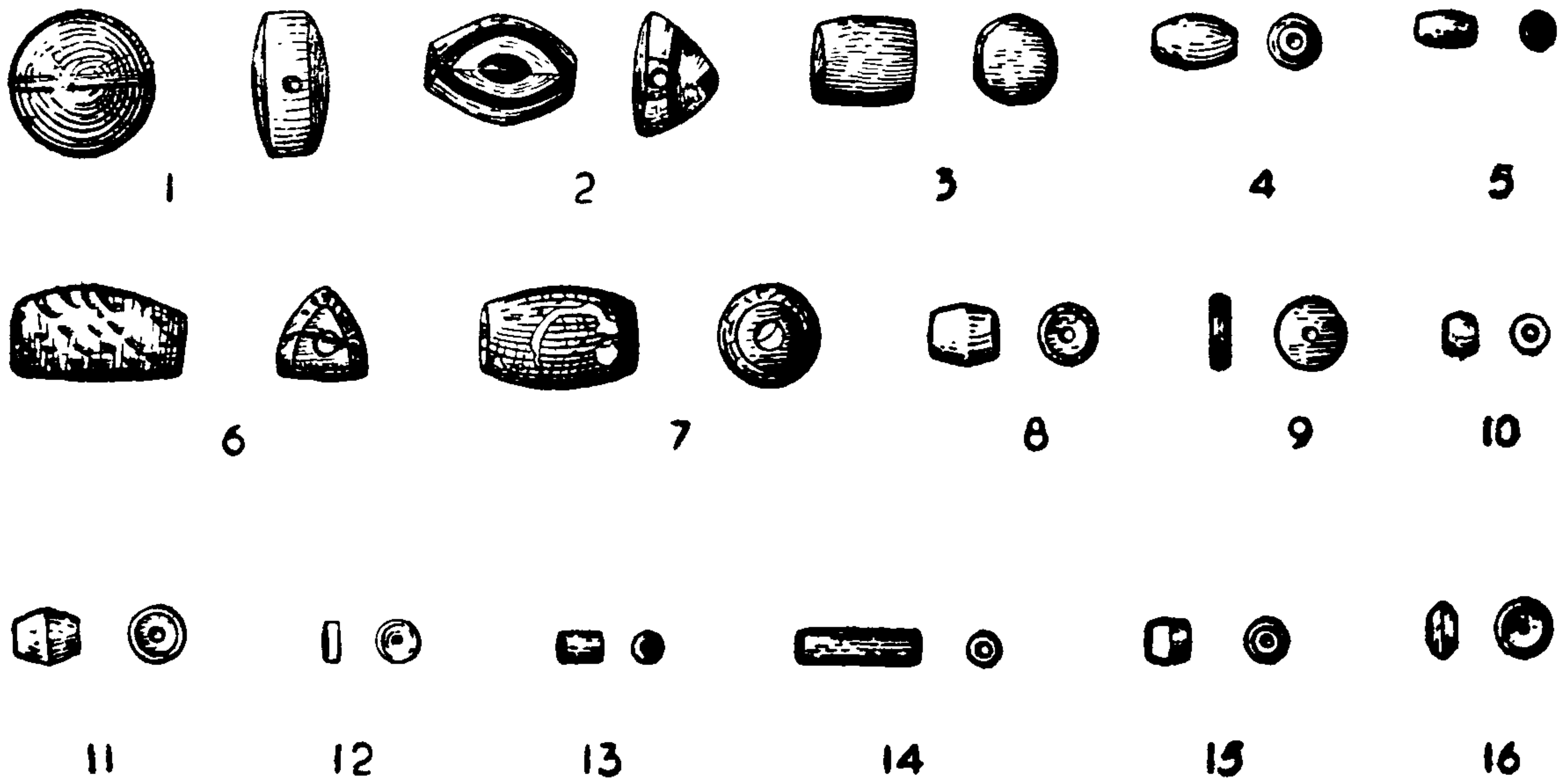

FIG. 130. *Agate beads, Scale 1/1*

2. Bluish white and grey, short barrel, ovoid. From phase II, Period A. (No. 12865).

3. Grey with brown and white bands, standard barrel, lenticular. From phase IV, Period A. (No. 13309).

4. Greyish white, standard barrel, circular. From phase II, Period A. (No. 2418).

5. Blood red and milky white, short truncated convex, ovoid. Circular 'Zone' of chalcedonic silica, From phase III, Period A. (No. 6050).

6. Olive grey, short truncated convexcone, plano-convex. Two 'Zones' resembling cat's eyes. 'Eye-bead' with two circles of chalcedonic silica. From phase IV, Period A. (No. 7549).

7. White and speckled with chlorophyll green, short barrel, rectangular. Moss agate. From phase II a, Period A. (No. 5051).

8. Chocolate with grey bands; standard cylinder, plano-convex. Chamferred. Highly polished. 'Boot-shaped' bead. From phase IV, Period A. (No. 12350).

9. Black and brown, short cylinder; ovoid. Moss agate. From phase IIa, Period A. (No. 1985).

10. Black with white bands, short barrel, lenticular; From phase V, Period B. (No. 14774).

11. Buffiish grey, short barrel, circular. From phase V, Period B. (No. 13589).

12. Deep black, standard barrel, circular. From phase III. Period A. (No. 9896).

13. Milky white and grey, short barrel, circular. From phase IV, Period A. (No. 13876).

14. Brownish red; short barrel, plano-convex. From phase II, Period A. (No. 1170).

15. Black and brown. Standard cylinder, lenticular. One surface chipped and another polished. Unfinished. From phase III, Period A. (No. 12917).

16. Deep red and grey. Standard barrel, lenticular. Jasperioid agate. From phase III, Period A. (No. 12630).

Carnelian. Fig. 131, Pl. CCLXX A

1. Deep red, short barrel, collared bead. One end damaged. From phase IV, Period A. (No. 11940).

2. Deep red, short truncated convex cone, circular. From phase V, Period B. (No. 13151).

3. Brownish red, convex bicone, circular (disc), From phase II, Period A. (No. 1048).

4. Deep red, short truncated convex bicone, circular. From phase IV, Period A. (No. 11045).

5. Deep red, standard bicone, diamond-shaped section with axial perforation. A fine specimen of etched bead. Three white concentric bands in groups of two on both the sides forming the figure '8'. From phase III, Period A. (No. 8750).

6. Red yellow and white bands in red matrix, standard lenticular, elliptical. Banded carnelian. From phase II, Period A. (No. 6052).

7. Orange red, short truncated, convex-bicone, circular. From phase III, Period A. (No. 11560).

8. Lemon yellow, short cylinder, rectangular. Sard. From phase III, Period A. (No. 2363).

9. Red, truncated bicone, circular (disk). From phase IV, Period A. (No. 12240).

10. Brownish red, short truncated bicone, circular. From phase IV, Period A. (No. 11981).

11. Brownish red, short cylinder, circular. From phase IV, Period A. (No. 11944).

12. Orange red, white and grey. Standard cylinder, plano-convex. Boot-shaped and banded. From phase IIa, Period A. (No. 801).

13. Brown, standard cylinder, circular. From phase III, Period A. (No. 2988).

14. Pale red, truncated convex-bicone, circular (disk). From phase IV, Period A. (No. 12884).

15. Blood red. Short truncated convex bicone, circular. From phase III, Period A. (No. 11034).

16. Red and brown, long cylinder, circular. From phase III, Period A. (No. 12856).

17. Deep red, short spherical, circular. From phase II, Period A. (No. 5992).

18. Poppy red, standard barrel, circular. From phase III, Period A. (No. 4079).

Jasper, Fig. 132, pl. CCLXX B

1. Blood red, standard circular, tabloid. From phase III, Period A. (No. 8422). Occurs in steatite also.

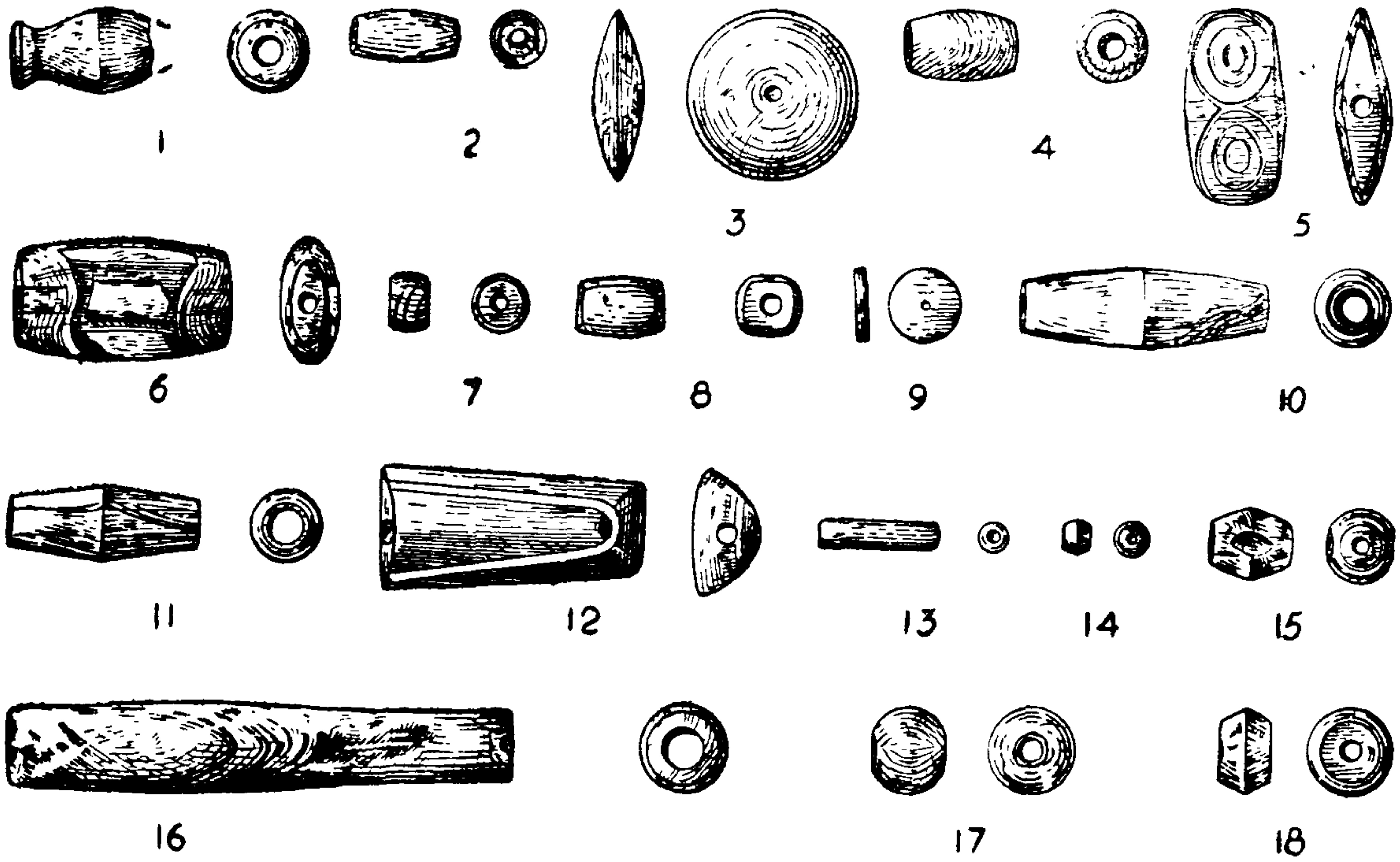

FIG. 131. *Carnelian beads, Scale 1/1*

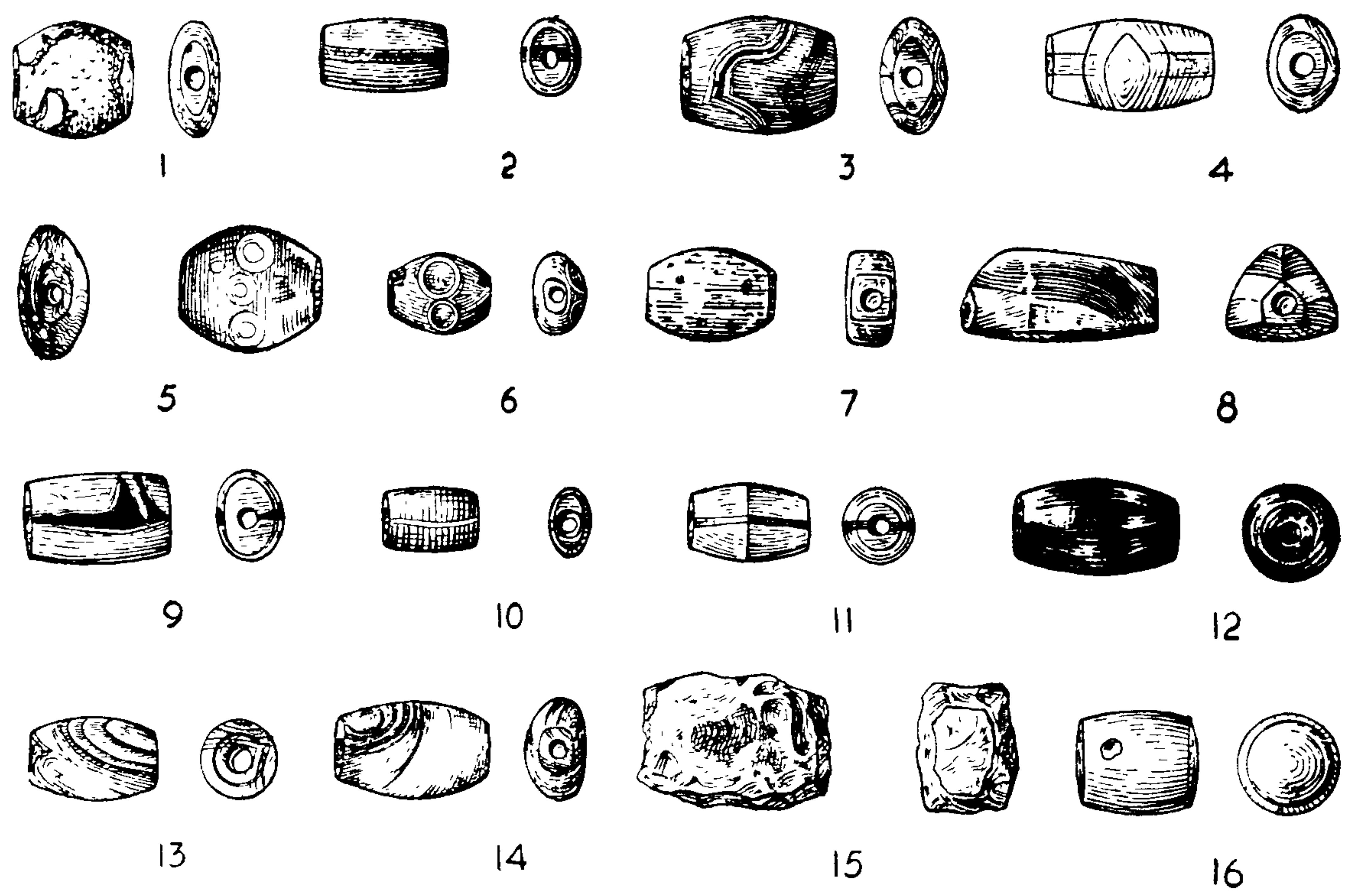

FIG. 132. *Jasper beads, Scale 1/1*

2. Deep yellow, short truncated convex-cone, plano-convex. Etched in black with eye-design. Unique. From phase II, Period A. (No. 5336).

3. Deep yellow, short cylinder, circular. Unpolished and unbored. From phase IV, Period A. (No. 7916).

4. Deep green, short barrel, circular. From phase IV, Period A. (No. 10606).

5. Brick red, short truncated convex-cone, circular. From phase V, Period B. (No. 14337).

6. Variegated deep red and greenish yellow; short cylinder, triangular. From phase IV, Period A. (No. 13644).

7. Deep green with white speckle, standard barrel, circular. Incompletely perforated and unfinished. From phase V, Period B. (No. 13186).

8. Deep red, short barrel, circular. From phase I, Period A. (No. 8011).

9. Brick red, barrel, circular. From phase V, Period B. (No. 12171). Occurs in gold and steatite also.

10. Brick red, short truncated convex-bicone, circular. From phase IV, Period A. (No. 12981).

11. Deep green, short cylinder, circular. From phase III, Period. (No. 1182).

12. Deep green, short cylinder, circular. From phase IV, Period A. (No. 4132).

13. Deep green, short truncated convex-bicone, circular. From phase V, Period B. (No. 13928).

14. Purple, short cylinder, circular. From phase II, Period A. (No. 6004).

15. Brick red, cylinder, circular (disk). From phase IV, Period A. (No. 13197).

16. Deep green, short barrel, circular. From phase IV, Period A. (No. 12206).

Onyx. Fig. 133; pl. CCLXXI

1. Parallel bands in yellow; brown and green; standard barrel, lenticular. Exceptionally well polished. From phase IV, Period A. (No. 10561).

2. Grey and white, short barrel, lenticular. From phase III, Period A. (No. 12943b).

3. Brown and milky white; short barrel, lenticular. From phase III, Period A. (No. 10391).

4. Flame-red, standard cylinder, lenticular. From phase IV, Period A. (No. 10445).

5. Milky white and brownish yellow, standard cylinder, lenticular. From phase II, Period A. (No. 1176).

6. Black and white bands, short barrel, lenticular. From phase III, Period A. (No. 504).

7. Dull white with brown bands, standard, cylinder, lenticular. Unbored. From phase IV, Period A. (No. 10407).

8. Brick-red, yellowish white, short cylinder, ellipsoid. From phase III, Period A. (No. 9987).

9. Brown, crystal white and blood-red, short convexcone, circular. From phase IV, Period A. (No. 13109).

10. Yellowish brown and white, Short, convex-cone, circular. From phase IV, Period A. (No. 12008).

11. Chocolate with blood-red parallel bands, standard truncated convex-cone, circular. From phase III, Period A. (No. 2933).

12. Buff with red and deep-red parallel bands. Standard convex-cone, circular. From phase IV, Period A. (No. 9334).

13. Crystal white with black bands, short cylinder, lenticular. Thin, well polished but unbored. From phase III, Period A. (No. 11281).

14. Brown with white bands, short cylinder, lenticular. Unbored. From phase III, Period A. (No. 7054).

15. White with milky white parallel bands, short cylinder, trapezoid. From phase IV, Period A. (No. 10592).

16. Milky white with crystal white bands, short cylinder, lenticular. From phase III, Period A. (No. 6799).

17. White and brown parallel bands, short truncated convex-cone, circular. From phase II, Period A. (No. 894).

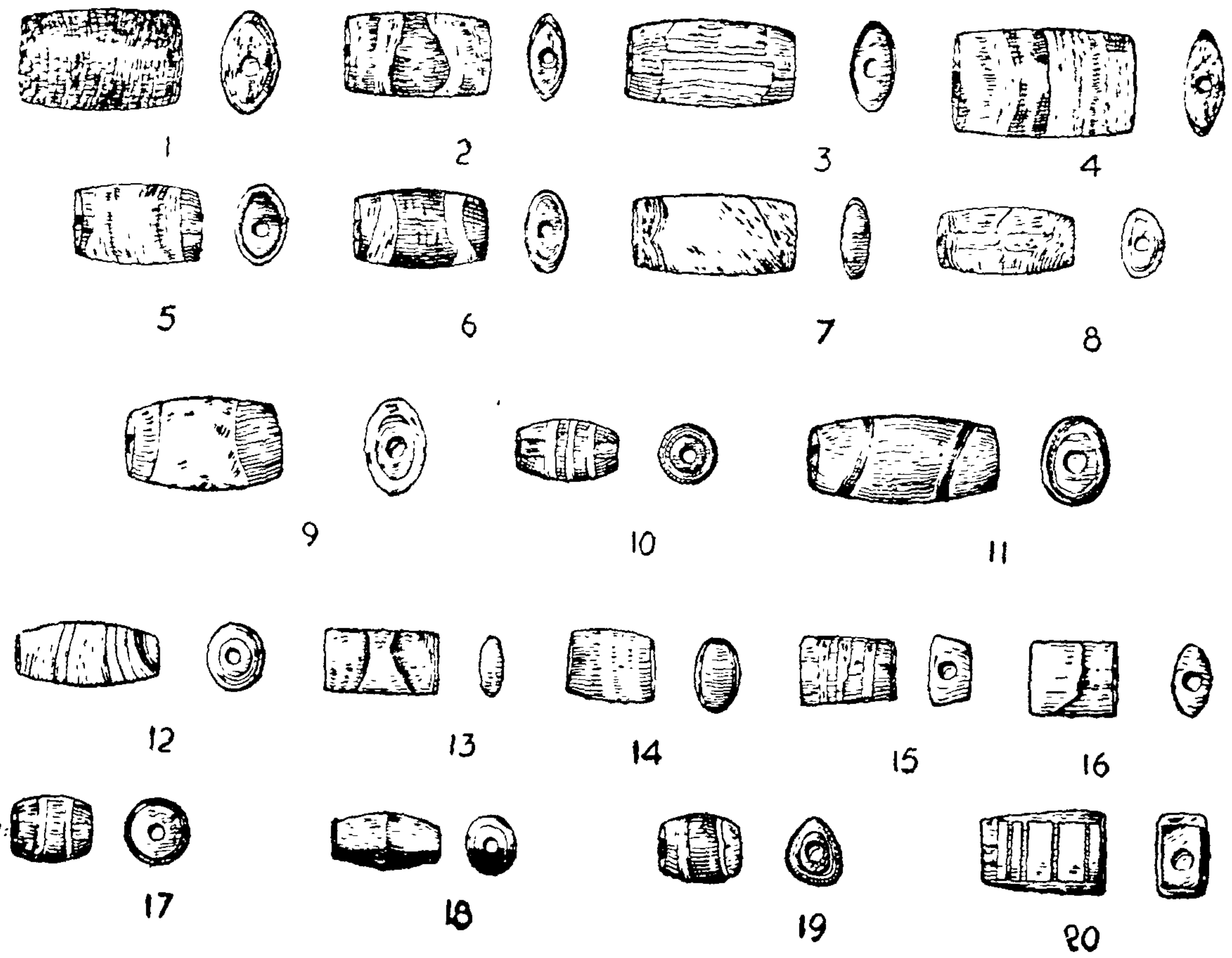

Fig. 133 *Onyx beads, Seal 1/1*

18. Black and grey, short truncated convex-cone, circular. From phase III, Period A. (No. 13559).
19. Grey with white parallel bands, short barrel, ovoid. From phase IV, Period A. (No. 14704).
20. Crystal milky white bands. Short cylinder, rectangular. Exceptionally well polished. From phase II, Period A. (No. 9096).

Assorted Stone beads. Fig. 134; pl. CCLXXII A

1. Plasma; deep red speckles in deep green matrix; standard cylinder lenticular. Exceptionally well-polished. From phase IV, Period A. (No. 224).
2. Cairngorm; smoky white, standard cylinder, lenticular, well-polished. From phase II, Period A. (No. 10058).
3. Bloodstone; brick-red and deep green, standard barrel, circular. Unfinished and unbored. From phase III, Period A. (No. 10390).
4. Blood-stone; blood-red and chlorophyl green, short cylinder, plano-convex, Unbored due to damage. From phase III, Period A. (No. 6899).
5. Chrysoprase; apple-green with waxy lustre, short truncated convex-cone, circular. From phase III, Period A. (No. 4745).
6. Amazonstone; green, standard barrel, circular. From phase IV, Period A. (No. 4180).
7. Amazonstone; green, standard convex-cone, circular. Damaged. From phase II, Period A. (No. 8965).
8. Amazonstone; green, short barrel, circular, From phase IV, Period A. (No. 14334).
9. Amazonstone; deep green, short barrel, elliptical. From phase III, Period A. (No. 13826).
10. Amazonstone, green, short cylinder, circular; From phase III, Period A. (No. 10385).
11. Opal; ashy white, short barrel, circular. Unbored. From phase IV, Period A. (No. 14772).
12. Chalcedony; white, short truncated convex-cone, circular. From phase IV, Period A. (No. 10781.)
13. Opal; milky white, short spherical, circular. From phase III, Period A. (No. 887).
14. Chalcedony, white, short truncated convex-cone, circular. From phase III, Period A. (No. 8846).
15. Rock crystal, crystal white, oblate, circular (disk). From phase III, Period A. (No. 9142).
16. Milky quartz, milky white, standard barrel, circular. From phase IV, Period A. (No. 13573).
17. Quartz; rose-red, standard barrel, circular. Damaged. From phase IIa, Period A. (No. 1426).
18. Granite; chocolate; standard cylinder, circular. From phase V, Period B. (No. 13096).
19. Chert, buff, short chamfered cylinder, circular. Unfinished, perforated. From phase IV, Period A. (No. 13670).

Miscellaneous beads. Fig. 135, Pl. CCLXXII B

1. Chalcedony; variegated marine blue and white, standard barrel, circular. Damaged. From phase IV, Period A. (No. 10612).
2. Steatite; black, long cylinder, circular. From phase III, Period A. (No. 4091).
3. Steatite; painted white in brick-red, standard barrel, lenticular. From phase III, Period A. (No. 4256).
4. Quartz; milky white, standard barrel, circular. From phase IV, Period A. (No. 13573).
5. Opal; whitish yellow; short barrel, circular. Unperforated. From phase II, Period A. (No. 3322). Probably used for setting in finger-ring.
6. Lazurite (Lapis Lazuli), azure blue; short cylinder, circular. From phase III, Period A. (No. 6229).

Copper. Fig. 136; Pl. CCLXXIII

1. Cylinder, tabloid. Spacer with five holes. From phase III. Period A. (No. 6387).
2. Cylinder, tabloid. Spacer with six holes. From phase III, Period A. (No. 26017).

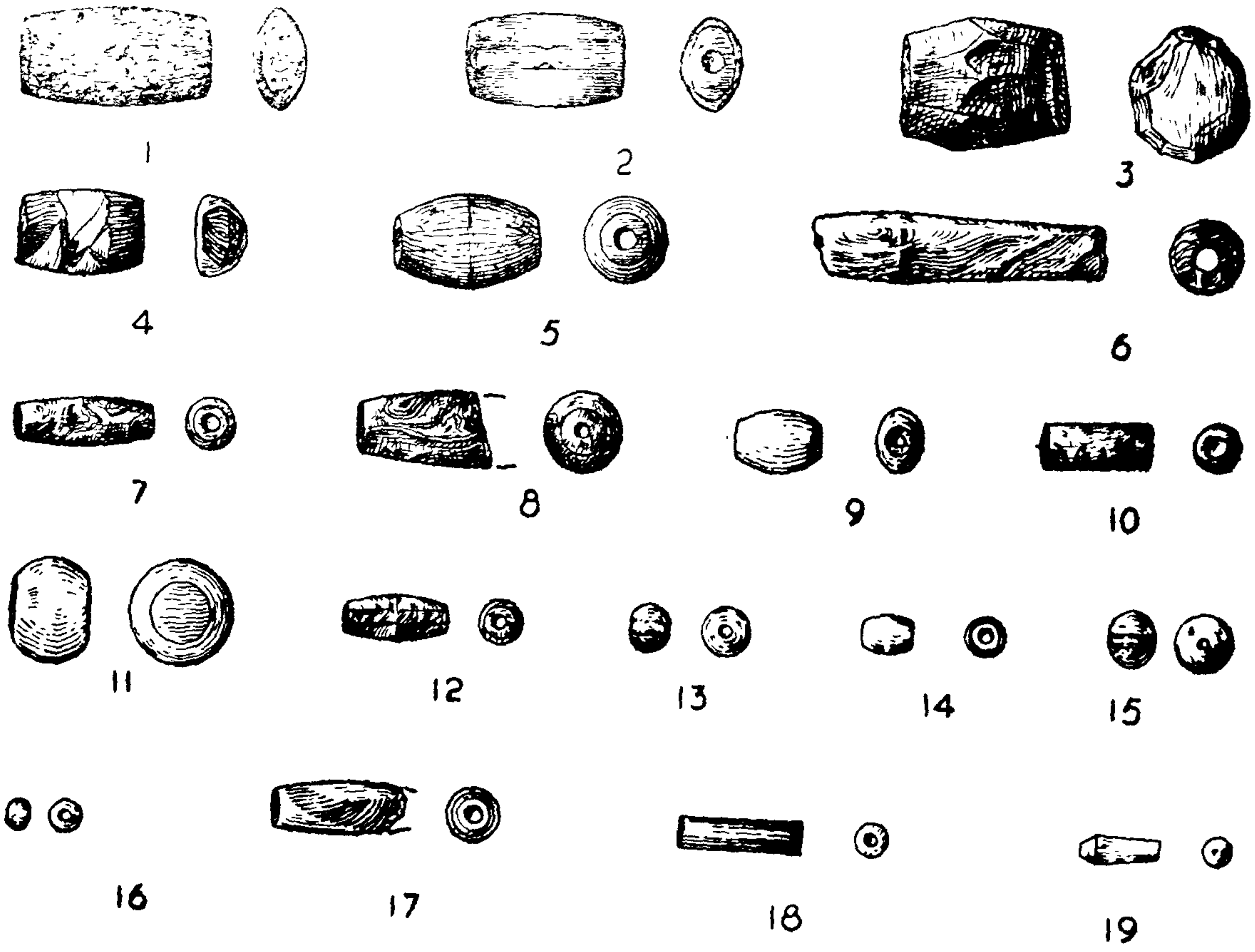

FIG. 134. *Assorted stone beads, Scale 1/1*

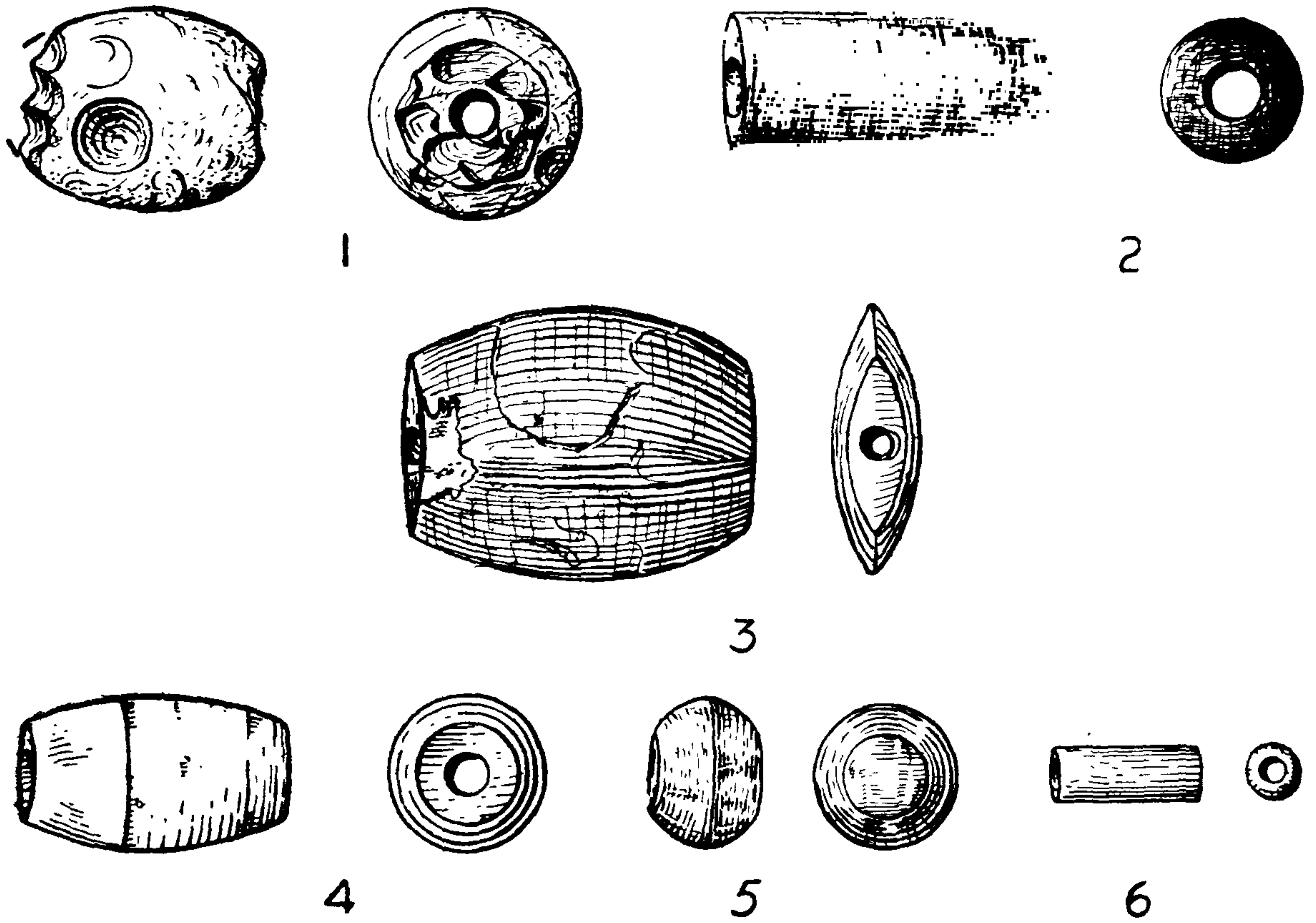

FIG. 135. *Miscellaneous beads Scale 2/1*

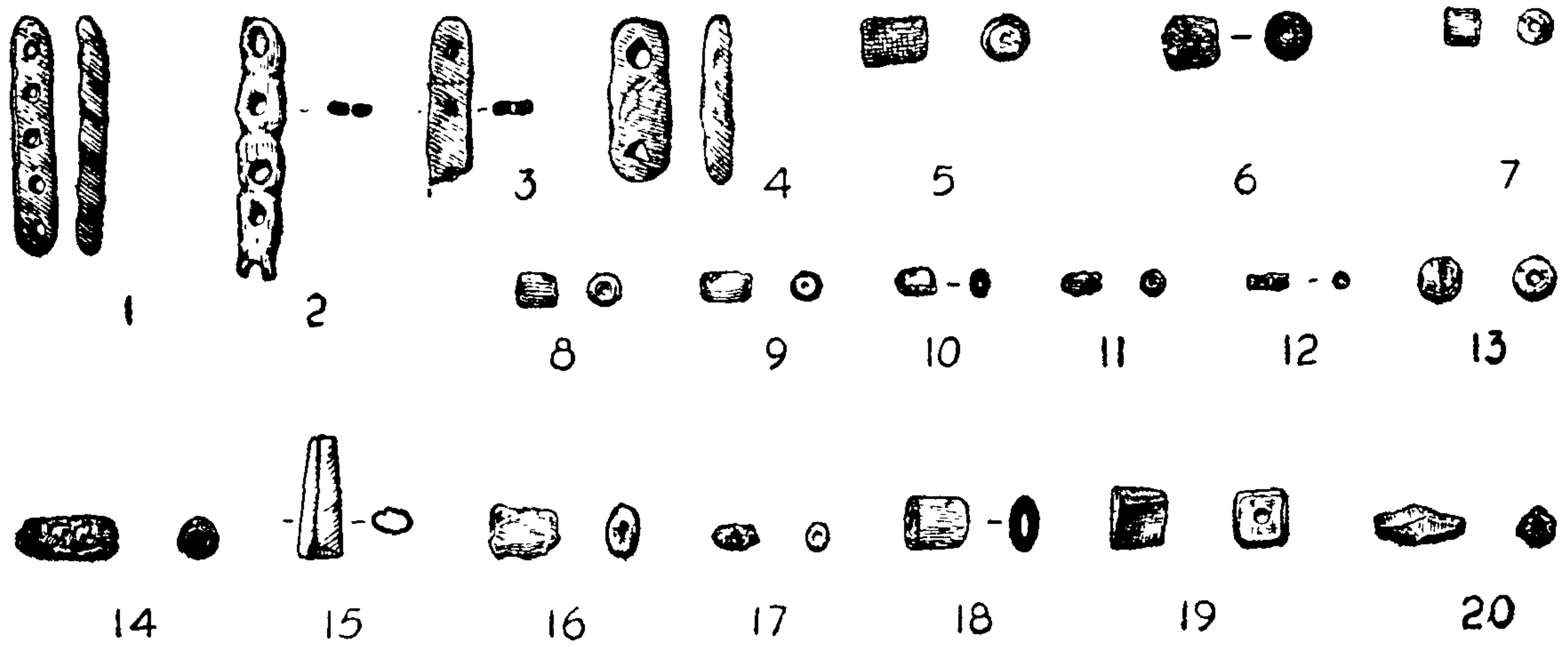

FIG. 136. *Copper beads, Scale 1/1*

3. Cylinder, tabloid. Spacer with two holes, one damaged. From phase III, Period A. (No. 3487).
4. Cylinder, tabloid. Spacer with two holes. From phase III-IV, Period A. (No. 5480).
5. Short cylinder, circular. Unfinished. From phase III, Period A. (No. 7175).
6. Short cylinder, circular. From phase III, Period A. (No. 3115).
7. Short cylinder, rectangular. From phase III, Period A. (No. 11569).
8. Short cylinder, circular. From phase II, Period A. (No. 5108).
9. Short barrel, cylindrical. Hole not clear. From phase IV, Period A. (No. 14583).
10. Short cylinder, circular. From Phase III, Period A. (No. 7169).
11. Short barrel, Circular. From phase III, Period A. (No. 6020).
12. Long cylinder, circular. From phase III, Period A. (No. 4465).
13. Spherical, circular. From phase II, Period A. (No. 360).
14. Standard barrel, circular. From phase IV, Period A. (No. 13122).
15. Cylinder, circular. From phase II, Period A. (No. 5520).
16. Short truncated, convex-cone. From phase III, Period A. (No. 2404).
17. Short convex-cone, circular. Both ends broken. From phase I, Period A. (No. 3964). Unique for being silver coated.
18. Short cylinder, lenticular. Perforation incomplete. From phase III, Period A. (No. 4466).
19. Cubical, a unique type. Unstratified. (No. 14872).
20. Short truncated convex-bicone, rectangular. Facetted. A unique type. From phase IV, Period A. (No. 11788). Occurs at Ur in the Royal Cemetery.

Pl. CCLXXIV

Carnelian, agate shell beads of variegated colour.

Pl. CCLXXV

Beads of faience, steatite and semi-precious stones.

CHAPTER XXII

OTHER FINDS

1. FAIENCE OBJECTS

A. Technique

Faience objects are generally made of a soft light grey or greenish paste and coated with a thick glaze, which in most cases has disappeared. A granular substance, grey to dull white in colour, resembling powdered steatite is mixed with another quartz-like granular material and pressed into a mould before firing. It is sometimes difficult to determine the ingredients after the faience paste is fired. Often, a soft glazed paste, greenish in section, produced by mixing crushed sand or quartz with a greenish substance, such as clay, is used as binding material which is necessary for holding the paste together before dipping it in a glaze. Subsequently the glazed paste is fired. Though no mould has been found either at Lothal or Mohenjo-daro the uniformity in the shapes of beads, vessels and bangles suggests that faience paste was pressed into moulds. Inspite of much labour and skill needed in manufacturing faience objects they were in use on a fairly large scale at Lothal.

Although the soil at Lothal is surcharged with salt many of the objects found in the excavations still retain their beautiful green colour and glossy surface. A few bangles and beads, however, show a pitted surface.

A period-wise break-up of the faience objects has revealed that faience almost disappeared in Period B, perhaps due to dearth of technical skill and low demand.

The report of the Archaeological Chemist on the analysis of faience and steatite objects is appended at the end of the chapter.

Among personal ornaments rings, bangles and ear-studs, were popular in phases II, III and IV, while beads were most popular in phase IV.

B. Objects of Domestic use

Miniature Vessels.—Two small vases of faience similar in shape to those from the Indus Valley have been recovered at Lothal also. They seem to have served as ungent vessels. One of them (pl. CLXXVI A, *2*), is dark grey in section and does not appear to have been fired to a high temperature. It bears finger-marks on the interior indicating thereby that the paste was pressed into a mould. A handle of a small vessel, probably a cup (pl. CCLXXVI A) *3*), with a highly glossy surface and whitish core shows traces of luting.

C. Personal Ornaments

Ear Ornaments.—Personal ornaments which account for the bulk of faience objects include ear-studs, bangles and rings. Ear ornaments of floral designs and sun-motif were more popular than other types. Flat circular pieces resembling the sun or cog-wheel motif have sharp teeth and a circular groove. This type of ornament occurs in steatite and terra-cotta also. Mackay suggests that such cogwheels were stitched over cloth as sequine. But

they can also be used as ear-ornaments with a thin stud of gold or copper inserted in the the hole. Such gold studs have been found at Lothal (pl. CCXCV B).

Ear studs of faience with a plano-convex top and a perforated knob at the back (pl. CCLXXVII A, *17*) are also found. Another type of ornament resembling a pulley, with a convex top and bottom, is incised with a lozenge pattern (pl. CCLXXVI, A, *4*). It occurs at Lothal, Harappa, Mohenjo-daro and in the middle neolithic levels of Knossos.[1]

A conical hollow pendant with perforations at the rim is a distinctive type (pl. CCLXXVI A *7*) noticed at Lothal and in the Indus Valley sites. The materials used are faience, steatite, gold, terracotta and copper.

Bangles.—Two types of bangles are found in faience. One of them has a circular or ovoid section (pl. CCLXXVI B, *2*) and the other a triangular section with a prominent mid-ridge (pl. CCLXXVI B, *1*). Both are decorated with incised oblique lines. Chevron is another design noticed on the former type (pl. CCLXXVI B, *5* to *7*).

pl. CCLXXVI A

1. Miniature ungent vessel with a convex profile; decorated with two parallel incised lines below the flat rim. Green glaze faded. Damaged. From phase II, Period A. (No. 246).

2. Miniature ungent vessel with a concavo-convex profile and narrow flat base. Green glaze faded. Damaged. From phase III, Period A. (No. 11901). Fig. 137, *1*

3. Handle of a vessel, perhaps a cup, with traces of luting. Faded green glaze. Damaged. From phase III, Period A. (No. 6394).

4. Ear-stud with hour glass section and two convex knobs, the larger knob incised with a lozenge design. Sea-green glaze. From phase III, Period A. (No. 809).

5. Ear-ornament (?) thin flat piece with a knife edge. Faded green glaze. Damaged. From phase II, Period A. (No. 2608).

6. Pendant; thin disk, rectangular section. Damaged. Faded glaze. From phase IV, Period A. (No. 6719).

7. Ear-pendant; hollow cone with two perforations near the rim. Faded green glaze. Unstratified, Period A. (No. 6036). This type occurs in gold and terracotta also.

8. Drop-pendant, spherical, circular in section; partially perforated. Faded blue. Unfinished. Unstratified. (No. 2419).

9. Ear-ornament, projecting teeth along the margin. Faded green. From Phase II, Period A. (No. 2863). Occurs in steatite also (pl. CCLXXVII A, *11*).Fig. 137, *3*

10. Ear-ornament of cog-wheel type with a circular groove on one side only; plano-convex in section. Faded green glaze. From phase V, Period B. (No. 11913). Fig. 137, *6*

11. Ear-ornament of cog-wheel type with a deep circular groove painted in red; almost rectangular section. Faded green glaze. From phase V, Period B. (No. 9943). This type occurs in steatite also (pl. CCLXXVII A, *12*).

12. Ear-ornament of cog-wheel type with deep circular incised groove on one side only; plano-convex section. Blue. From phase III, Period A. (No. 4493).

13. Ring; corrugated exterior. Sea-green glaze. From phase III, Period A. (No. 4680). This type occurs in gold (pl. CCXCVI B, *14*) and shell (pl. CCLXXXII A).

14. Ring; rectangular in section. Grass-green glaze. Decorated with shallow grooves across the surface. From phase V, Period B. (No. 9692).

15. Ring; corrugated exterior. Green glaze. From phase III, Period A. (No. 12251).

16. Ring; delicate; ovoid in section. Grass-green glaze. From phase III, Period A. (No. 1472).

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[1]Evans, *The Palace of Minos*, (1921) I, 55.

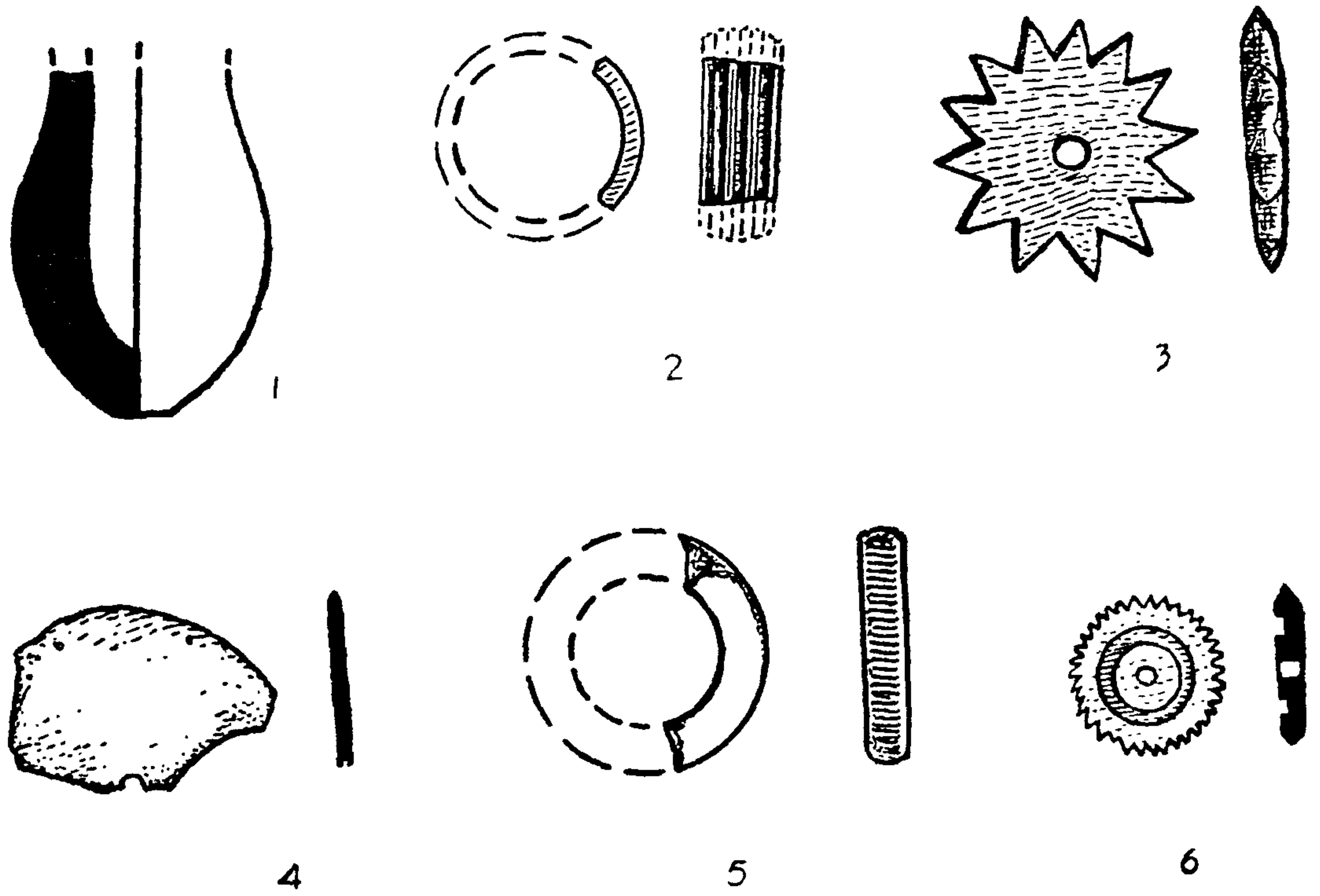

FIG. 137. *Faience and steatite objects. Scale 1/1*

17. Button; plano-convex; embossed and transversely perforated. Weathered. From phase III, Period A. (No. 3132).

pl. CCLXXVI B

18. Bangle; plain; triangular in section. Light green. From phase III, Period A. (No. 4464).

19. Bangle; plain; circular in section. Light green glaze. devitrified. From phase IV, Period A. (No. 14373).

20. Bangle, ovoid in section. From phase II, Period A. (No. 1473).

21. Bangle; triangular section. Decorated with incised lines. Sea-green. From phase II, Period A. (No. 1737).

22. Bangle; plano-convex section. Decorated with incised parallel oblique grooves. Sea-green. From phase V, Period B. (No. 6926).

23. Bangle; circular in section; Decorated with incised lines in chevron pattern. Sea-green. From phase IV, Period A. (No. 2659).

24. Bangle; circular in section. Decorated with deep incised composite chevron design. Light-green. Unstratified, Period A. (No. 12805).

2. STEATITE OBJECTS

A. Technique and Source

Steatite is an impure variety of talc with 4 to 8 percent of water. Though very soft, it gains hardness by losing water at red-heat, and its colour changes into white. It can be polished also. The Lothal folk were very well acquainted with the properties of the material. It was probably calcined before firing.

Small blocks of steatite, light yellow, grey or black in colour found at Lothal (pl. CCCCCLXIV) are apparently pieces rejected after cutting seals from larger blocks. It is not unlikely that such rejected pieces were crushed into powder and compressed into blocks to make beads, ornaments and even seals.

An inferior variety of steatite is available in North Gujarat and North coast of Kathiawar, but there is no evidence to show that it was exploited in protohistoric times. The probable source of the raw material has been discussed earlier (above p. 583).

B. Personal Ornaments

Bangles.—Steatite was sparingly used for making bangles. Plain as well as decorated ones are found at Lothal. Incised lines in chevron pattern are seen on bangles with a triangular or round section (pl. CCLXXVII A *1* to *4*) as in the case of faience bangles. A bangle-like object has a rectangular section and is decorated on one side with oblique incised lines (pl. CCLXXVII A).

Finger-rings.—There is only one type of ring which is a hollow cylinder with a corrugated exterior (pl. CCLXXVII A, *8*). Similar ones are found in faience and gold also.

Ear-ring,—The cog-wheel type of ear-ring (pl. CCLXXVII A *10* to *14*) or stud resembles closely the ear-ornaments in faience. It appears to have been fixed in position with the help of a gold or bronze knob or a copper-screw-pin.

Ear-stud.—The only ear-stud with a floral pattern in steatite found at Lothal has a knob at the back with a transverse hole (fig. 137, 3) and can be fixed with a copper or gold pin. Similar studs occur in shell, faience and terracotta also.

BROOCHE.—Brooches of floral design having four petals each with a serrated edge and marginally incised lines have been found at Lothal (pl. CCLXXVII A, *16* to *17*). One of them is painted in red ochre which is faintly visible in the grooves. In another case a yellow pigment seems to have been used. Harappa and Mohenjo-daro have yielded similar brooches.

EAR-PENDANT.—A hollow conical ear-pendant of a large size perforated at one end is found in steatite (pl. CCLXXVII A) and closely resembles those in terracotta, gold and faience.

C. MISCELLANEOUS OBJECTS

Two-heart-shaped ornaments with or without concentric outlines in relief exactly, resembling those from the Indus sites have been found at Lothal (pl. CCCCCLXXVI) Whether they were worn on the head or stitched on garments is not known.

The buttons in steatite are of three types A disk-button with a plano-convex section and converging holes in the flat base is a characteristically Harappa type noticed at Lothal in faience (pl. CCLXXVI A, 17), shell (pl. CCLXXXII A) and steatite (pl. CCLXXVII A-B). Another type of buttons is square on plan with two converging holes slightly away from the centre. A unique geometric pattern is engraved on it. The third type has a disk base, small shaft and conical head (pl. CCLXXVII B).

The only specimen of a lid found in steatite has a disk-base and conical top (pl. CCLXXVII A, *22*). Similar ones are found at Harappa and Mohenjo-daro.

A rod with chiselled end and circular section appears to have been used by the mason as a pencil to mark lines etc., on hard surface.

Pl. CCLXXVII A

1. Bangle; circular section; plain. From phase III, Period A. (No. 4452).
2. Bangle; circular section; plain; bluish glossy surface. From phase V, Period B. (No. 14127).
3. Bangle; triangular section; plain. From phase II, Period A. (No. 478).
4. Bangle; trapezoid section; plain. From phase V, Period B. (No. 3089). Also occurs in faience.
5. Bangle, rectangular section; incised oblique lines. From phase II, Period A. (No. 337).
6. Bangle; trapezoid section; plain. From phase II, Period A. (No. 742).
7. Bangle; circular section; deep incised grooves in chevron design. From phase V, Period B. (No. 10739). Occurs in faience also.
8. Ring; deeply corrugated across the surface on the exterior only. From phase V, Period B. (No. 7427). Occurs in faience in shell and gold.
9. Pendant, standard disk with a lenticular section and axial hole. Might have been used as a bead also. From phase IV, Period A. (No. 6392).
10. Ear-ornament of cog-wheel type; plain. From phase III, Period A. (No. 965).
11. Ear-ornament of cog-wheel type; plain. From phase IV, Period A. (No. 15277).
12. Ear-ornament of cog-wheel type; incised circle. Unstratified, Period B. (No. 10467). Occurs in faience also.
13. Ear-ornament of cog-wheel type; a deep circular groove. From phase III, Period A. (No. 4814).
14. Ear-ornament of cog-wheel type; rectangular section; plain; damaged. From phase II, Period A. (No. 1084).
15. Ear-stud, circular on plan and irregular in section; petals indicated by marginal slits. From phase IV, Period A. (No. 647).

16. Ear-ornament, hollow cone perforated along the margin of the base. The largest of the type. Perhaps used as head-ornament also. From phase III, Period A. (No. 5699). Occurs in terracotta, faience and gold also.

17. Ear-ornament of floral design with two oval-shaped saw-edged petals; two more petals missing. Groove along the margins of petals and in the central piece. From phase II, Period A. (No. 438).

18. Ear-ornament; only one saw-edged petal available. Decorated on one side with a deep groove and painted in red. From phase II, Period A. (No. 1180).

19. Pendant or seal; square on plan and rectangular in section; perforated on the reverse axially but away from the centre. Incised *swastika* design. Might have been used as a stamp seal also. From phase II, Period A. (No. 4839).

20. Pencil; fragment of a rod with a chiselled end and blunt point, circular in section. Might have been used for writing on slate-stone. From phase III, Period A. (No. 4778).

21. Button with a disk-top and perforated across the stud at the back. From phase II, Period A. (No. 10281). Occurs in faience also.

22. Button, disc; plano-convex in section with a transverse perforation. Unstratified, Period A. (No. 14873).

23. Knobbed lid. From phase II, Period A. (No. 5746). Type occurs in terracotta also.

Pl. CCLXXVII B

1. Heart-shaped ornaments. Unstratified. From phase III, Period A.

3. SHELL OBJECTS

A. Source and Technique

Various types of marine, estuarine and fresh-water shells were used at Lothal in the manufacture of precision instruments, ladles, engravers, knives, inlay pieces, gamesmen, personal ornaments such as beads, bangles and pendants and occasionally for seals. Hundreds of columella of chank-shell, rejected flakes, unfinished bangles and other finished objects of shell found in the workshops of Lothal confirm that shell-working was a flourishing local industry.

Shri V. K. Chari has examined and indentified all the varieties of shells found in the excavations. According to him the marine shells including the chank are those of the species of Molusca occurring in the Arabian Sea. With the exception of chank they are ordinarily met with on the Indian shores as well. The chank-shell itself occurs in the Gulf of Mannar and the Kathiawar coast especially near Beyt-Dwaraka. At Amra and Lakhabawal, the Late Harappan sites near Jamnagar, are known for the chank-shell industry. The fresh-water shells and marine varieties from Lothal fall into three well-defined classes of Molusca, namely, the Gastropoda, the Lamelli-branchia (Pelecypoda) and the Scaphopoda (pls. CCLXXXIII to CCXC-B) all of which were worked by the Lothal craftsman.

Lothal was a very important centre for shell-working. One of the workshops of shell-workers encountered in Street 1 was devoted to shell-bead industry. The process of sawing engraving and giving final shape to the shell objects was almost identical in Kathiawar and the Indus Valley. The columella of the chank-shell was extracted by swerving off a slice of the lip with the help of a wire-saw pl. CCLXXVIII A), and breaking down the septa with a hammer. The apex of the shell was then smashed and the columella freed, thus leaving a hollow tubular piece of shell which can be readily sawn into bracelets. The saw-

marks on the columella (pl. CCLXXVIII A) and the valva clearly show that the shell was turned slowly while sawing with a bronze wire. Mr. Hornell's view that the shells were cut with the help of flint or toothed-saw is not borne out by facts.

The remnant of the septum between adjacent whorls left after removing the columella was chipped off with great care as it forms the weakest part of the ring. The thick rings produced from the septum (pl. CLXXVIII A) were then sawn into thinner pieces for making bangles. According to Hornell the inside of the segment is rubbed down with a a wooden spindle coated with river sand embedded in lac. The walls of chank shell were sometimes used for making ladles and inlay-pieces and the solid part of the columella for making gamesmen, ear-stud etc.

Shell objects are broadly divided into four categories, namely (1) objects of domestic use, (2) tools and instruments (3) ornaments and (4) gamesmen.

B. Objects of Domestic use (pl. CCLXXVIII B)

Ladles.—The walls of the chank-shell were made use of in preparing ladles which vary in diameter from 1·42 ins. to 4·6 ins. They have a short solid handle and a smooth surface which is partly due to deliberate rubbing and partly due to use. It is interesting to note that shell ladles of the type found at Lothal were in use at Kish also.[2] A disproportionately large number of columella and rejected pieces found at the site suggest that Lothal was a factory site and finished products were exported.

Bowls.—Small shell bowls with flaring walls were made by joining four concave parts with the help of an adhesive. In some cases a metal-string passing through the holes held the walls together. Similar bowls are found at Harappa and Mohenjo-daro also. Horizontal lines incised along the rim and running across the walls are seen on some of the bowls. The interior of the vessels was very well polished and painted as indicated by red ochre in the grooves. Two examples of bowls revetted by wires are illustrated here in pl. CCLXXVIII B 6-9. but the purpose of having a hole in the bottom of the bowls is is not clear. It is often suggested that such objects were also used as inlay pieces.

C. Tools and Instruments (pl. CCLXXX A)

New types of tools and instruments made of shell have come to light at Lothal. Among them is a hollow cylindrical object used by masons for measuring angles. A 'bridge' and a plectrum used in a musical instrument also deserve special mention. Other objects include knives, engravers, burnishers and needles.

Knife.—A shell object with a thick tapering blade and tang is considered to a knife (pl. CCLXXX A). It must have been hafted in a wooden frame. The blade and handle are partly damaged, leaving a small portion of the sharp cutting edge.

Engravers and Scrapers.—The Lothal artisan has cleverly made use of broken bits of shell bangles by chiselling and sharpening one or both the ends to convert them into engravers and scrapers (pl. CCLXXX A, *2-3*). Some of them have a sharp point at one end, while others have a sharp margin also. Both the types must have been used for engraving on steatite seals. The bevelled margins in some cases are deliberately produced for comfortable handling (pl. CCLXXX A, *5*). The sickle-shaped engraver with a smooth surface is best suited for engraving as it can be held very conveniently between the thumb and first finger.

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[1]J. Hornell, *Memoirs of the Asiatic Society of Bengal,* III (1910) 14.

[2]M. Watel in; *Excavations at Kish,* IV (Paris 1925-30) p. 25; pl. XVIV 8.

Burnishers.—Fragments of bangles have been turned into burnishers by blunting the edges and margins (pl. CCLXXXA *7*). They must have been used for burnishing earthen wares.

Needle.—A long tapering shell object perforated at the broader end has a chisel-edge. It must have been used as a needle for sewing leather or mattings. Its piercing end is broken.

Handle.—A cylindrical hollow object with a deep groove running horizontally along the margin at one end must have served the purpose of a handle of a tanged knife, sickle or dagger.

Compass.—(Pls. CCLXXIX A and B). The most interesting instrument made of shell is what is considered to be a compass used as an angle-measuring instrument. It is a hollow cylindrical object with symmetrical loop-like curves produced at regular intervals by partially sawing across the opposite margins. Four grooves each can be seen on the lower and upper margins of the cylinder. If opposite grooves on the upper margin are joined by stretching cords they cut each other at right angles. So do the other four on the lower marings. If all the inter-secting lines on both margins meeting at the centre of the circle are drawn on a plain surface, the eight angles so formed measure exactly 45° each. The instrument must have served the same purpose as a modern compass. It could be highly useful in fixing the alignments of the roads, lanes and house-walls. Perhaps it was also used in land-survey. Similar objects found at Harappa and Mohenjo-daro are considered to be pendants. As the threads get stuck up in the grooves they could not have been kept in position to be used as pendants. In view of the narrowness of the central hole they could not have been used as finger-rings. How exactly they were used for measuring angles is demonstrated in pl. CCLXXIX B. (See Appendix II)

Plectrum and 'Bridge'.—A leaf-shaped object (pl. CCLXXX B), with a semi-circular end found at Lothal is supposed to have been used as a plectrum for playing on a stringed instrument. It is thin, flat and well-polished and serves the purpose of increasing the volume of sound when it touches wires. Plectrums of wood and metal are used nowadays while playing on violin, harp and similar instruments. Two Indus signs engraved on seals are in the form of a harp. One of them is two-stringed. Hence it is not unlikely that the Indus people knew the harp especially because their contemporaries used it. Another object of interest is a 'bridge' also used in a stringed instrument. It has two grooves through which wires can pass (pl. CCLXXX B). The object can be used in any other stringed instrument.

D. Personal Ornaments

Bangles.—Bangle-making was an important industry at Lothal as suggested by the workshops. Large rings were sawn off from *chank*-shells to the required thickness to produce bangles and rings. Several finished bangles and unfinished ones found at Lothal give a clue to the process of cutting smaller and thinner bangles from thick rings with a wire-saw. The inner margin of the bangle was rendered smooth by rubbing with a file and the outer surface was polished (pl. CCLXXXI A, *15-16*). Most of the bangles have a triangular or trapezoid section but in a few cases, a rectangular or ovoid section is seen. Externally they have a ridge or groove. A bangle, with a corrugated exterior is a unique specimen (pl. CCLXXXI A, *7*) from Lothal.

Rings.—A large variety of rings made of shell for use on the fingers or in the ears has come to notice. One of the thicker varieties with a corrugated exterior may have been used as a finger-ring (pl. CCLXXXII A, *1*), but the greater probability is that it served the purpose of a handle. Smaller ones in gold (pl. CCXCVI B) and faience (pl. CCLXXVI

A) were however used as rings. Some rings have a rectangular section while others have a plano-convex section. The most interesting type is a small ring with a thin section. It has a knob-like projection in imitation of stone-studded ring (pl. CCLXXXII A, *6*).

E. Miscellaneous Objects

Inlays.—Inlay pieces are of varying shapes and sizes with or without perforations. The perforated ones were fixed in wood by means of copper or wooden pins (pl. CCLXXXII, A, *7, 8, 11, 12*). Most of the inlay pieces are rectangular or square on plan, while a few are leaf-or diamond-shaped (pl. CCLXXXII A, *6, 7* and *12*). Very few are semi-circular and grooved. The incised designs consist of segmented squares and criss-cross pattern. Small circular pieces with plano-convex section (pl. CCLXXXII A, *14-15*) seem to be buttons and fragments of bangles with smoothened edges were used as inlay-pieces (pl. CCLXXXII B, *9-10*).

Ear-stud.—Ear-ornaments in shell are very rare. A cylindrical knob perforated axially and having a button-top appears to have been used as an ear-stud. The knob in this case is meant to be fixed horizontally in the ear-lobe with a bronze or gold pin passing vertically through the hole at the back (pl. CCXCV B, *5*).

Gamesmen etc.—(pl. CCLXXXI B). Three conical objects in shell with a circular convex top, narrow waist and flat base found at Lothal must have been used as gamesmen. Two of them have horizontal grooves.

Unfinished gamesmen in the form of cylindrical pieces, as also rectangular tablets cut from the cores of shells, suggest the various stages of working gamesmen, inlay pieces and pendants.

Pl. CCLXXVIII A

1. Chank-shell from a small portion of the wall is sawn off before breaking the columella.

2-3. Columella of chank-shell from which thick rings are sawn off.

4. Wall of a chank-shell from which a small vessel, ladle or an inlay piece can be made.

5. A thick ring sawn off from a chank-shell after breaking the columella.

6-7 and 10. Columella cut into suitable bits for making inlay pieces, gamesmen, ear-studs, buttons etc.

8. A circular piece from the wall of the chank-shell for making inlay.

9. Fragment of an incised inlay piece.

Pl. CCLXXVIII B

1. Ladle of large size with a long handle. Damaged. From phase IV, Period A. (No. 6348).

2. Ladle of medium size. From phase IV, Period A. (No. 2627).

3. Ladle of medium size. From phase V, Period A. (No. 8978).

4. Ladle of small size. From phase IV, Period A. (No. 10435).

5. Ladle of small size. From phase V, Period B. (No. 6559).

6. Ungent vessel made of three parts of which two are found; flat base and convex sides; horizontal groove along the rim and radiating ones from the base. Interior polished. From phase II, Period A. (No. 977).

7. Fragment of a vessel with convex sides and tapering rim; perforation along the margin of the piece for purposes of securing with a wire. From phase III, Period A. (No. 14633).

8. Fragment of a vessel with two perforations. One margin ground. From phase III, Period A. (No. (4160).

9. Fragment of a vessel with an incised line along the margin; flat base faintly visible; groove painted in red ochre. From phase IV, Period A. (No. 14786).

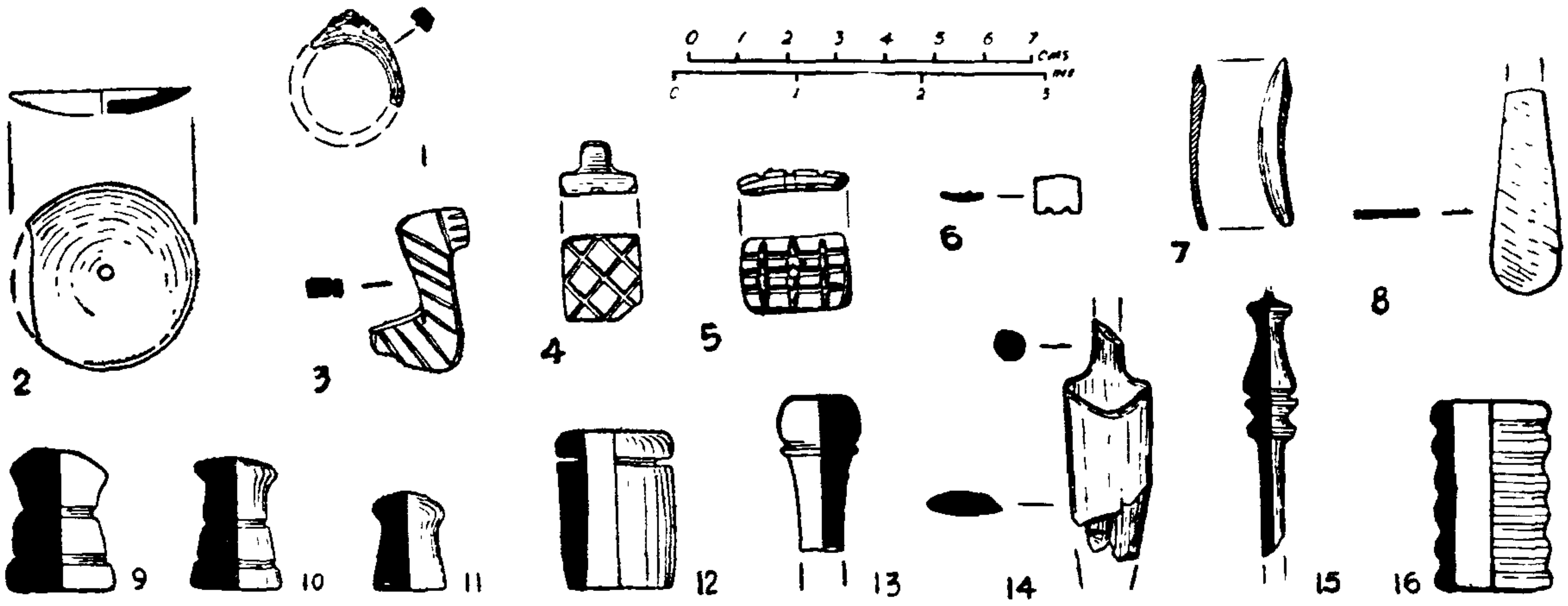

FIG. 138. *Shell objects*

Pl. CCLXXX A

1. Knife, lenticular section, thick tapering blade and a short tang. Arc engraved near the base of the tang. From phase IV, Period A. (No. 5608).

2. Engraver produced by blunting a bangle-fragment, crescentic; pointed at one end; The convex margin blunted From phase II, Period A. (No. 12104) Fig. 138, *7*.

3. Engraver produced by blunting a bangle-fragment; both margins blunted but one end is sharp. From phase III, Period A. (No. 929).

4. Scraper produced by blunting a bangle fragment; both ends semi-circular and chisel-edged; use-marks visible. From phase III, Period A. (No. 8739).

5. Point, lunate-shaped; one end pointed; blunted cord. From phase II, Period A. (No. 14615).

6. Point produced by blunting a thin bangle-fragment; tapering curved end. From phase III, Period A. (No. 11735).

7. Burnisher produced by grinding a bangle-fragment; triangular section. From phase IV. Period A. (No. 3428).

8. Handle of a ladle; broken. From phase III, Period A. (No. 12105).

9. Needle with eye at the broader end. Piercing end broken. From phase IV, Period A. (No. 1939).

10. Handle of a tool; hollow cylinder with deep horizontal groove at one end. From phase II, Period A. (No. 144). Fig. 138, *12*.

Pl. CCLXXIX A-B

A. Compass; fragmentary; From phase III, Period A.

B. Compass with eight grooves, four on either margin; hollow cylinder. From phase IV, Period A. (No. 3792).

Pl. CCLXXX B

1. Plectrum; thin; leaf-shaped. One end broad and rounded and the other broken. Perhaps used for playing on a stringed musical instrument. From phase II, Period A. (No. 7357). Fig. 138, *8*.

2. 'Bridge' of a stringed musical instrument. Roughly square, on plan and tabloid in section: two semi-circular grooves on the rim for strings to pass through. From phase III, Period A. (No. 14424). Fig. Fig. 138. *6*.

Pl. CCLXXXI A

1. Bangle, unfinished; trapezoid section. From phase III, Period A. (No. 12261).

2 Fragment of a bangle; triangular section From phase III, Period A

3. Bangle, irregular section; mid-ridge. From phase III, Period A. (No. 4486).

4. Fragment of a bangle; triangular section with a mid-ridge. From phase IV. Period A. (No. 12583).

5-6. Fragments of bangles; trapezoid section; margins rubbed. From phase IV, Period A.

7. Fragment of a corrugated bangle. Perhaps used as a wristlet. From phase IV, Period A. (No. 7844).

8. Bangle. Irregular section with a mid-ridge. From phase III, Period A. (No. 12105).

9. Bangle fragment; triangular section with a mid-ridge. From phase II, Period A. (No. 14259-F).

10. Fragment of a bangle; ovoid section. Surface find. Period A.

11. Fragment of a bangle; irregular section; deep wide grooves on the exterior. From phase II, Period A. (No. 12106).

12-13. Fragments of bangles; irregular section and low mid-ridge; polished. From phase III, Period A. (Nos. 6227 and 6227 A).

14-15. Fragments of bangles; round section; From phase III, Period A.

16. Fragment of a bangle; triangular section and mid-ridge. From phase II, Period A.

Pl. CCLXXII A

1. Ring; hollow cylinder, corrugated exterior and smooth interior. From phase II, Period A. (No. 333). Occurs in gold also.

2. Ring, round section. From phase IV, Period A. (No. 1023).

3. Ring; rectangular section; damaged. From phase V, Period B. (No. 10531).

4. Ring; elliptical section; damaged. From phase III, Period A. (No. 12103).

5. Ring; ovoid section; damaged. From phase III, Period A. (No. 3171).

6. Ring; trapezoid section with a knob-like projection. damaged. From phase V, Period B. (No. 559). Fig. 138, *1.*

7. Inlay with three perforations; rectangular; slightly concave section; polished interior; incised criss-cross design on exterior. From phase II, Period A. (No. 6780).

8. Inlay with a single perforation; rectangular, plano-convex section, incised with criss-cross design; Worn-out. From phase III, Period A. (No. 6952). Fig. 136, *5.*

9. Inlay; S-shaped; oblique parallel lines incised on exterior From phase V, Period B (No. 11251). Fig. 138, *3.*

10. Inlay; circular with convex top; almost disk-like. From phase IV, Period A. (No. 7105).

11. Inlay; circular with two perforations and rectangular section; incised criss-cross pattern. From phase III, Period A. (No. 11226).

12. Inlay; square with a button at the back and incised; criss-cross design on surface; perhaps used as a stamp seal. From phase III, Period A. (No. 9268). Fig. 138, *4.*

13. Inlay; Floral pattern with a tang. From phase V, Period B. (No. 6048). Similar inlays are found in Mari at the end of third millennium B.C. in the Larsa period.

14. Inlay; circular (disk), plano-convex. From phase II, Period A. (No. 520). Fig. 138, *2.*

15. Inlay; circular (disk); plano-convex. Unfinished. From phase V, Period B. (No. 13093).

Pl. CCLXXXII B

1. Inlay; ovoid, rectangular. From phase III, Period A. (No. 2043).

2. Inlay; diskoid, rectangular. From phase II, Period A. (No. 2662).

3. Inlay; diskoid, rectangular. From phase II, Period A. (No. 14599).

4. Inlay; disk, rectangular. From phase V, Period B. (No. 12522).

5. Inlay; circular, plano-convex, triple parallel lines radiating from the centre. Broken. From phase IV, Period A. (No. 3007).

6. Inlay; diamond-shaped, plano-convex. From phase III, Period A. (No. 9745).

7. Inlay; same as above; From phase V, Period B. (No. 14740).

8. Inlay; double convex, rectangular; From phase III, Period A. (No. 10169).

9. Inlay; square, tabloid. From phase III, Period A. (No. 8365).

10. Inlay; trepezoid; tabloid. From phase IV, Period A. (No. 11348).

11. Inlay; oblate, rectangular. From phase II, Period A. (No. 6537).

12. Inlay; diamond-shaped, rectangular. From phase II, Period A. (No. 1263).

13. Inlay; oblong, rectangular. From phase II, Period A. (No. 4799).

14. Inlay; circular, diskoid. From phase IV, Period A. (No. 6973).

Pl. CCLXXXI B

1. Gamesman; conical with button top and disc base. Two horizontal grooves round the body. From phase IV, Period A. (No. 7628). Fig. 138, *9.*

2. Gamesman; Same as above. From phase III, Period A. (No. 2532). Fig. 138, ***10.***

3. Gamesman; conical with disk top and base. From phase II, Period A. (No. 540). Fig. 138, ***11.***

F. Report on the Collection of Molluscan Shells from Lothal
by Shri V. K. Chari.

The Lothal collection of the Molluscan shells (Pl. CCLXXXIII) may be considered under two broad heads viz., the Township-collections and the Dock-collections.

(i) The Township-collections

These include several articles made out of chank Xancus (Turbinella; pyrum (linn.) like bangles, rings, ladles, spoons etc., and a large number of its rejected cut-pieces, consisting of body-portions, columella and spires, indicating that the Chank-industry was flourishing in the township of this prehistoric port.

The chank (Pl. CCLXXXVIIB) a species strictly confined to Indian waters occurring nowishere else in Asia. The central or the type-form of this species is found only in the Gulf of Mannar inSouth India and in the Kathiawar coast in Western India. At many places along the Kathiawar coast from Dwaraka to Beyt, the Chank occurs in sufficient abundance to warrant a Chank-industry in these parts including the township of this prehistoric port as, from time immemorial, Beyt and Dwaraka, the two important places of Hindu pilgrimage have been affording a good market for the materials made out of Chank.

(ii) The Dock-Collections

These include both marine and fresh-water species of shells, falling into three well-defined classes of the Mollusca viz., the Gastropoda or univalves, the Lamellibranchia (Pelecypoda) or bivalves, and the scaphopoda or Tusk-shells, which can be placed in 19 clear-cut families. They are as follows :

Marine Shells

Class : Gastropoda

(Pls. CCLXXXIV to CCLXXXVI A and CCLXXXVIIC)

I. Family *nertitidae*

Nerita albicilla Linn.	1
Nerita polita Linn.	1
Neritina crepidularia Lamk.	1

II. Family *Potamididae*

Potamides cingulatus (Gmelin)	3
Terebralia palustris (Linn).	13
Telescopium telescopium Linn.	23

III. Family *Cypraedae*

Cyprace pallida Gray	5
Cypraea arabica var. histrio Gmelin	4
Cypraea errones Linn.	3
Cypraea arabica Linn.	2
Cypraea onyx Linn.	2

IV. Family *Muricidae*

Murex trapa Roding	1

V. Family *Buccinidae*

Cantharus spiralis (Gray)	1

VI. Family *Xancidae*

Xancus (Turbinella) pyrum (Linn).	2

VII. Family *Olividae*

Ancilla ampla (Gmelin)	1

VIII. Family *Faciolariidae*

Fusus (Hemifusus) Sp.	1

IX. Family *Conidae*

Conus figulinus Linn.	1
Conus ebraeus Linn.	3

Class : *Lamellibranchia (Pelecypoda)*

Pls. CCLXXVI B & CCLXXXVII A

I. Family *Arcidae*

Acra inequivalis Brug.	2 valves

II. Family *Chamidae*

Chama macrophilla Chem.?	1 valve.

III. Family *Cardiidae*

Cardium oxygonum Sow.	1 valve.
Chione imbricata Sow.	1 ,,

V. Family *Mactridae*

Mactra cornea Desh.	1 ,,
Standella capillaceae Desh.	1 ,,

Also there were several broken pieces of Arc and Venus shells (pl. CCLXXXVIII B) whose specific identity was not possible.

Class: *Scaphopoda*

Pl. CCLXXXVIII

Family *Dentaliidae*

Dentalium octangulatum Donovan	12
Dentalium Sp.	2

Fresh-water shells

Class: *Gastropoda*

Pl. CCLXXXIX

I. Family *Viviparidae*

Vivipara dissimilis (Muller) a large number.

II. Family *Dimnaeidae*

Limnaea (Gulnaria) *pinguid* (Dohrn)	Several
Planorbis (Indoplanorbis) exustus Desh.	,,

III. Family *Pilidae* (pl. CCXC A)

Piloglobosa (Swainson)	Several

Class: *Lamellibranchia (Pelecypoda)*

Pl. CCXC B

I. Family *Unionidae*

Parreysia (Parreysia) corrugata (Muller)	Several valves.
Lamellidens marginalis (Lam.).	,,

(iii) General remarks on the Collections

All the marine shells including the chank are those of the species of the Molluscs occurring in the Arabian Sea and with the exception of the chank all of them are ordinarily met with on any of its shores in India.

The solitary juvenile undamaged and uncut chank among the Dock-collections might either have been brought in by the sea-waters touching the dock of may be a rejected specimen for its small size.

The slightly damaged knobbed chank-*Fusus* Sp. of the Fasciolariidae is also used in the Chank-industry. This particular species collected here, is, however, rare in Indian waters.

The fresh-water shells also are all common and have wide distribution in India.

(iv) Conclusion

This mixture of fresh-water and marine shells in the dockyard inclines one to the opinion that there was undoubtedly a touch of the arm of the sea at the dock-area, produc-

ing as a snsult, estuarine conditions. Among marine shells of the dock-area the comparative abundance of the Horn Shells *Telescopium telescopium* Linn. and *Terebralia palustris* (Linn) of the family Potamididae, which have marked tendency to migrate from sea to land, confirms this view. This tendency on the part of these species, accounts for their appearance in large numbers in swamps, mudflats and estuaries, which they easily adapt themselves to, though they are primarily marine in their habitat.

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(i) Amphineura and Gastropoda—Bull Madras Govt. Museum—New Series Vol. I and II. Pt. 6.

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(ii) Scaphopoda, Pelecypoda and Cephalapoda, Vol. I and II Pt. 7.

4. BONE OBJECTS

The paucity of bone objects in the Indus Valley, Kathiawar and Mesopotamia may be due to the friable nature of the material. Most of the bone implements found at Lothal are made out of ribs of large mammals including the ox, buffalo etc. They consist of sharp-edged or keen-pointed objects such as the arrow-head, awl and needle rather than other types of tools which can be produced easily on account of the fracture of the bones. Stylii, antimony-rods, weaver's scrapers, engravers and spatula are among other bone tools found at Lothal. A finely polished spatula pointed at one end and tapering at the other forming almost a tang (pl. CCXCI) has been recovered. It is rather difficult to distinguish between awls and needles in many cases as the tip is broken. Generally, those which have atleast one point sharp are considered as needles (pl. CCXCI, 7).

As many as twentysix pins and awls varying in length from 2 to 4·5 inches and having a single or double point were found along with a stone-anvil in the Acropolis in a house assignable to phase IV. They are polished and have a round or chiselled butt and must have been hafted. The section is circular or plano-convex. Obviously a bone-worker lived in Block B after the Acropolis ceased to be occupied by the rulers as a sequel to the flood in phase III. A notched blade of chert (pl. CCLVA) found in association with the awls suggests that it was used for polishing them.

Scrapers (pl. CCXCI,) used by weavers are found to have been made of bone. Even now such small scrapers made of wood are used by the weavers in Kathiawar for adjusting the warps and wefts on the loom. Besides shells and chert, bone was also made use of at Lothal by engravers. They are either straight or curved (pl. CCXCI,) and have a sharp point for engraving on steatite and other soft materials. Cutting and sharpening bone must have been done with the help of knives and razors made of chert, copper and bronze. Flat pieces of bone with sharp edges were used as razors or blades for cutting soft material.

[1]Hargreaves, *Memoir of the Archaeological Survey of India* No. 35, p. 57.

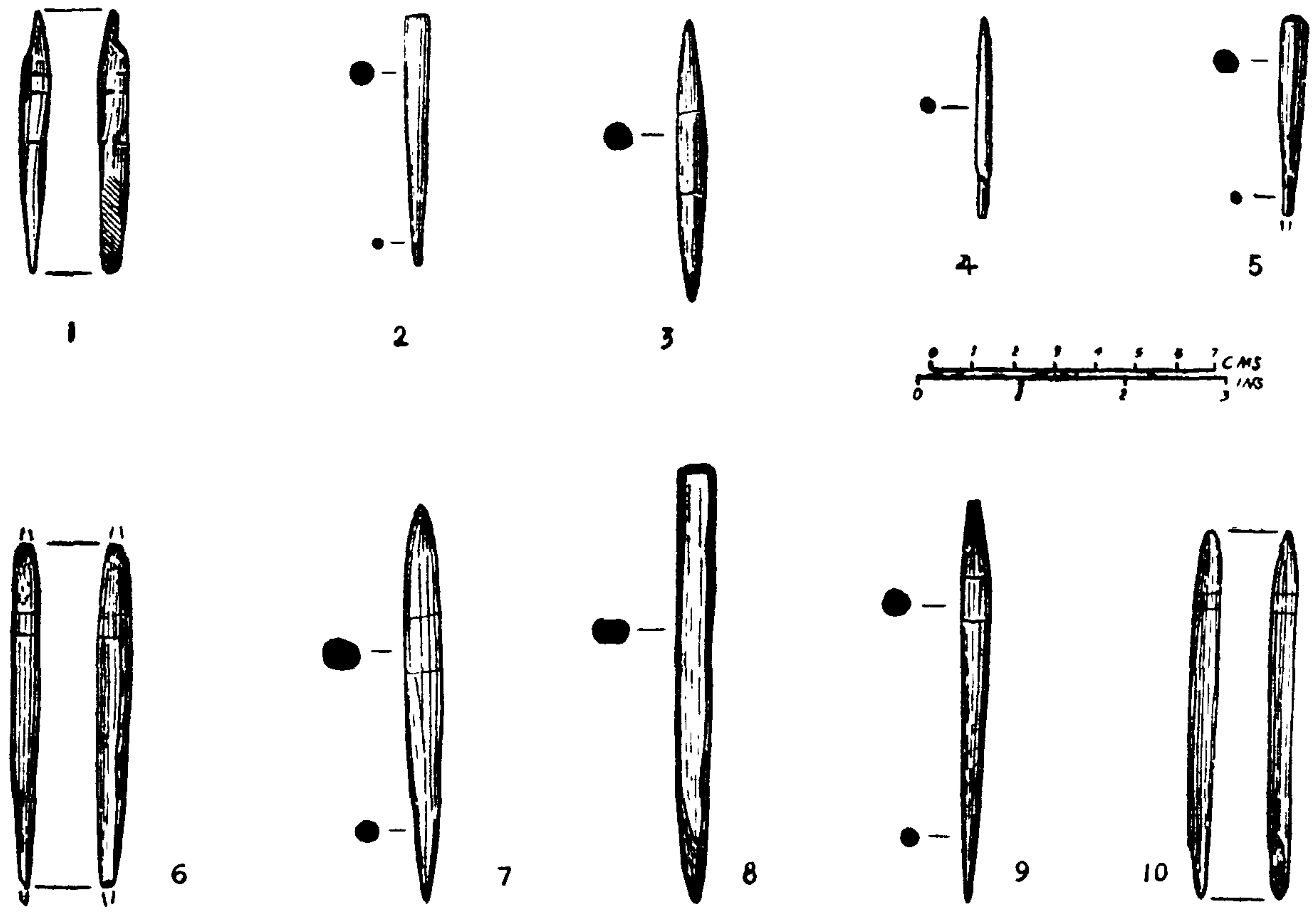

FIG. 139. *Bone objects*

approximately equal to the distance between two circles in the Mohenjo-daro scale[1] i.e. 33·46. The sixth and twentyfirst lines are marked longer than others and it is, therefore, highly probable that the scale was divided decimally. The first ten divisions give a distance of 17·5 mm. and if the mean error is added, it comes to 17·7 mm. The unit of 17·7 mm. almost equal to the *aṅgula* referred to in the *Arthaśāstra* which Raju and Mainkar have equated to 17·86 mm. The Lothal scale may be said to be nearer traditional metrology. The Mohenjo-daro scale illustrated by Mackay is a piece of shell on which lines are finely marked with a circle on one mark, and on the fifth mark later there is a hollow circle. The line indicating each division is said to be 0·5 mm. thick, the division itself being 6·7 mm. (0·264 ins.). The distance between the full circle and the hollow circle is presumed to have been divided decimally. The tenth division is also marked off with a full circle, thus the unit may be taken to be 67·056 mms. (2·64 ins). The mean error of graduation in each division is said to be 0·075 mm. The length of basic recurring unit is taken to be 67 mm. The bronze rod from Harappa bearing four marks, each at an average interval of 0·934 cm. is considered to be a scale[2] The Indus people appear to have followed the decimal system with 13·2 ins. for 'foot'. Five units on Mohenjo-daro scale would measure 13·2 ins. (2·64 × 5). Though the unit namley, 2·64 ins., might have been the same in the case of Lothal and Mohenjo-daro, it is noticed that the Lothal scale is divided into smaller sub-divisions for more accurate measures. The door-widths and the dimensions of the houses and granary at Harappa and Mohenjo-daro are found to be multiples of units in the Indus scale. It is also interesting to find that the dimensions of the Indus seals can be accurately measured in terms of the sub-divisions of the Lothal scale, as illustrated in Table XX. The dimensions of some of the rooms are also found to be multiples of the

Table XXIII

Seal	Scale
No.	No. of subdivisions in terms of Lothal scale
1. 3017	25
2. 5321	22
3. 5040	20
4. 7341	17
5. 15164	15
6. 5397	13

divisions on the Lothal scale. It is however most probable that the multiples of 1·7 mm were used for architectural purposes since the door-widths, roads, lanes etc., are found to be multiples of the basic unit of 67 mm.

According to the *Arthaśātra* there were three *hasta* measures. One of them, of 28 *aṅgula* used for commercial purposes, works out to 50 cm. or half a metre. The *Prajāpatya hasta* of 24 *aṅgula* was not popular.

[1]L. Raju and V. B. Mainkar in *Metric Measures,* (New Delhi, 1964), Vol. 7, no. 1, pp. 3-9. Also see Appendix II.

[2]Vats, *op. cit.* (1945), I, p. 365.

Ceremonial Knives.—Two ivory knives were found at Lothal. One of them has a 0·6 in. wide blade with sharp margins and a tapering end (pl. CCXCII, *1*). Another knife has a broad blade with a convex end. Both must have been used as ceremonial daggers or knives but there is little possibility of having been used for cutting hard substances.

Engraver.—A lunate-shaped ivory object (pl. CCXCII, *4*) has a pointed end and blunt convex margins. It can be held comfortably between the fingers. The tang at the other end was meant for hafting. This tool must have been used as an engraver, and can cut steatite.

Antimony rods.—Two types of rods used for toilet are noticed in ivory. One of them is single-pointed and the other is double-pointed. The single-pointed rods are sharp while the others have one end blunted. Some were perhaps used for knitting also. Generally all have a circular section.

Awl.—A rod with a chisel-edged tip which must have been hafted in a wooden handle was used as an awl. Another type has a triangular section.

C. Personal Ornaments

Hair-pin.—A solitary specimen of hair-pin which comes from Period B, has a tapering shaft and a large button-head above two sharp ridges. Such hair-pins are found at Harappa and Mohenjo-daro also.

Ear-stud.—This unique ornament consists of a thin disk fitted to a short tapering rod for fixing in the ear-lobe.

Ear-ornament.—A flat rectangular tablet with truncated corners and a hole in the centre (pl. CCXCII) appears to have been used as an ear-ring. Even now such larger earrings of gold are used by women in India. They are sometimes held by a gold wire passing through the upper part of the ear.

Pendant.—A tablet with concave margins and two holes in the centre occurs in phase II of Period A at Lothal. Incised lines in chequered pattern are noticed on one side. Such pendants in bone and ivory are used nowadays by the aboriginies.

D. Miscellaneous Objects

Gamesmen.—Ivory was also used at Lothal for making gamesmen as in Egypt and Sumer. One of the gamesmen has a conical body, a clubbed top and slightly convex sides. Similar ones occur in shell (pl. CCLXXXI B) and terracotta (pl. CCXXVIII B). Such chessmen made of ivory are popular in India.

Another type of gamesmen is a cube with a short tapering handle. A circle is found incised enclosing a perforation in the centre. Mackay has reported a gaming piece in ivory from Mohenjo-daro,[1] but the one in bone from Tepe Gawra VI is said to be a pendant.[2]

Rods.—(pl. CCXCII and CCXC III) Several ivory rods with a circular or rectangular section with or without a disk-top are recorded at Lothal. In a few instances the thinner end is rounded off and the thicker end is flat. Most of the rods must have been turned on lathes as indicated by the uniformly smooth surface and the central blind hole at the thicker end. One of the suggestions made is that they were used as stopper-cum-ungent rods. It is most interesting to note that similar ivory rods have been found at Ras

[1]Mackay *op. cit.* II, 1939, pl. CXXXIX.

[2]Speiser, *op. cit.* 1935 p. LXXXII, 25.

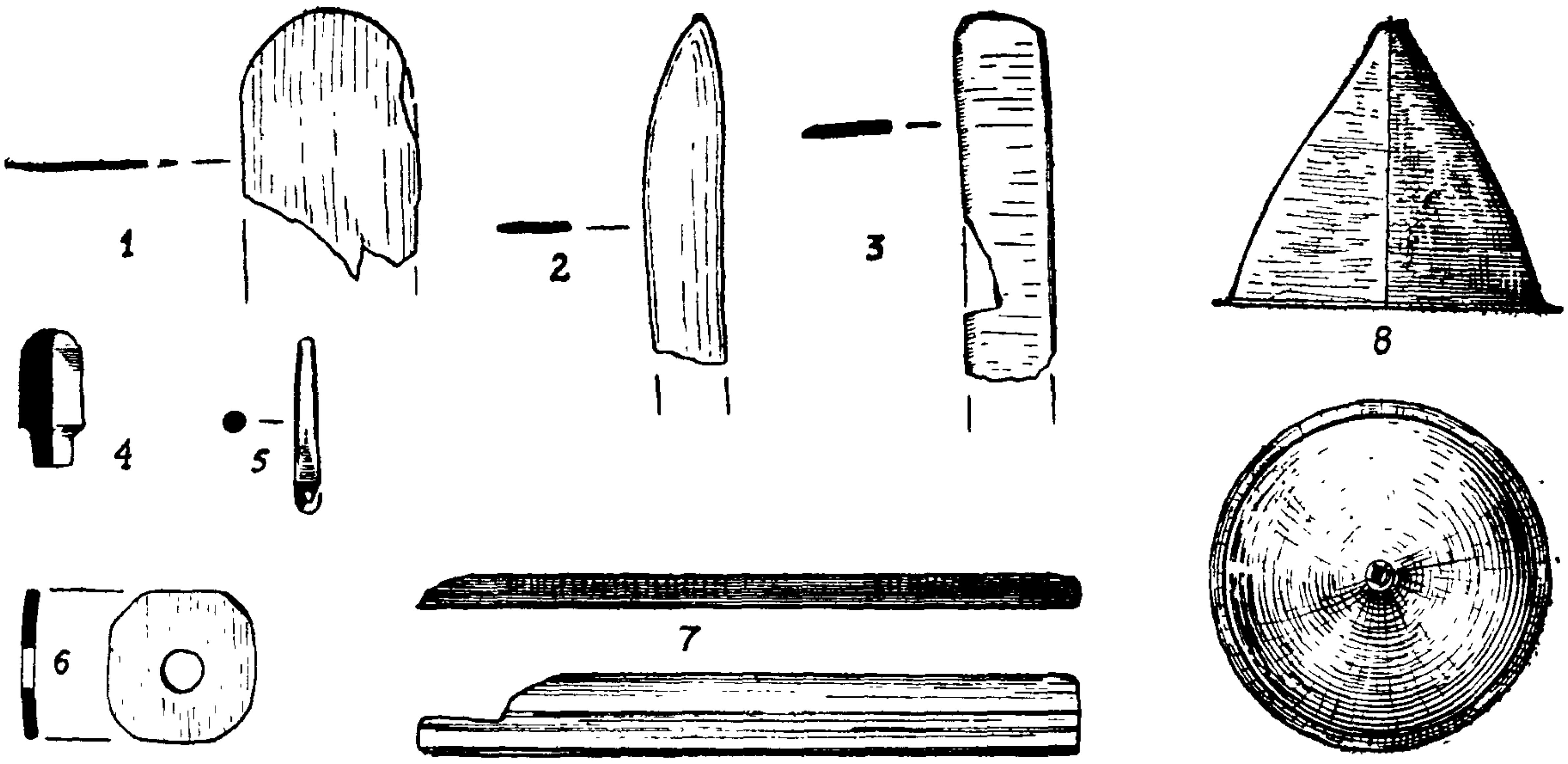

FIG. 140. *Ivory (1-7) and gold (8) objects*

Shamra (Ugarit III). Another rod has a disk-head but its thicker end is broken. A rod with a square section and partially perforated at one end has a hole right through in the centre. Perhapt it was used for drawing circles by rotating it on a pivot.

STOPPER.—A stopper with a clubbed top and short handle (pl. CCXCIII *13*) is made of ivory. The container on which it was used must have had a very narrow mouth.

KOHL ROD.—A small tapering rod of ivory (pl. CCXCIII) on which stains of red ochre are seen at the tip must have been used for decorating lips or nail-tips. A chemical examination of the pigment reveals that a paint has been applied.

The phasewise distribution of ivory objects suggests that Lothal enjoyed greater prosperity in phases II and III than in phases IV and V.

Pl. CCXCIV B

Scale, rectangular section. Well-polished. Thirty divisions visible on the longitudinal side, the rest being effaced. From phase III, Period A. (No. 3859). Fig. 140, *7*[1].

Pl. CCXCII

1. Ceremonial knife; thin blade and curved tip. Margins blunted; Damaged. From phase III, Period A. (No. 11864). Fig. 140, *2*.
2. Ceremonial knife; slightly curved and semicircular top. Thin margins. Damaged. From phase V. Period B. (No. 8994). Fig. 140, *1*.
3. Knife; rectangular in plan and section. Blunt margins. Damaged. Unstratified. Period A. (No. 2493). Fig. 140, *3*.
4. Ceremonial dagger; lunate-shaped; thin; rectangular section. Pointed at one end and tanged at the other. Might have been used for engraving also. From phase II, Period A. (No. 5805).
5. Awl; round section; pointed at one end and chiselled at the other for hafting. Polished. From phase III, Period A (No. 1333).
6. Awl; round section; Pointed at one end; damaged. From phase V, Period B. (No. 10103).
7. Knitting needle; round section; pointed at one end. Damaged. From phase II, Period A. (No. 6023).
8. Knitting needle; round section, pointed at both ends. Polished. From phase III, Period A. (No. 7247).
9. Awl; round section; sharp point at one end and blunted butt at the other. Polished. From phase V, Period A. (No. 7008).
10. Awl; plano-convex section; both ends pointed. Slightly damaged. From phase II, Period A. (No. 5797).
11. Awl; round section of varying thickness. One end pointed and the other damaged. From phase IV, Period A. (No. 14720).
12. Awl; round section. One end thinned and chiselled for hafting. From phase II, Period A. (No. 5214).
13. Kohl rod; round section; tapering; button-top with groove at one end. Damaged. From phase III, Period A. (No. 5890).
14. Awl; rectangular section; sharp point at one end. Damaged. From phase III, Period A. (No. 8212).

Pl. CCXCIII

1. Hair-pin; stem with round section and conical panelled top above two ridges. Damaged. From phase II, Period A. (No. 14396). Fig. 140, *4*.

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[1]See Appendix II.

2. Ear-stud; tapering stem with a round section; A disk fixed on the tapering end. From phase II, Period A. (No. 4116).

3. Ear-ring; disk-like object with a large perforation in the centre. From phase IV, Period A. (No. (No. 13103).

4. Pendant with concave margins and two perforations in the centre. Closely incised lines in chequered pattern. Might have been used as inlay also. From phase IV, Period A. (No. 15291).

5. Gamesman; conical, club-topped and flat based. Similar ones occur in terracotta and shell also. From phase II, Period A. (No. 382).

6. Gamesman, cube with a handle. Transverse perforation enclosed by incised circle; concentric circles on top also. From phase II, Period A. (No. 5229).

7. Tapering rod with a conical top; round section; two concentric circles incised on the base; Well polished. From phase III, Period A. (No. 4303), Similar ivory rods occur at Ras Shamra.[1]

8. Tapering rod with conical top and flat base; round section; polished. From phase IV, Period A. (No. 15228).

9. Cylindrical rod with a spheroid head; round section; blind hole in the flat base. Might have been used as a ceremonial macehead. From phase III, Period A. (No. 4770).

10. Cylindrical rod with a nail-head; round section; damaged. From phase II, Period A. (No. 5221).

11. Cylindrical rod; damaged. From phase II, Period A. (No. 4514).

12. Rod; with a transverse blind hole and another running through the body at the point of breakage. Square section and uniform sides. From phase III, Period A. (No. 5894). Might have been used as an architectural instrument.

Pl. CCXCIV A

Ivory tusk partially cut for further working. From the ivory worker's shop in the Acropolis. Phase III, Period A.

Table XXIV

Sl. No.	Objects	Period A	Period B	Unstratified	Total
1.	Scale (Linear Measure)	1	—	—	1
2.	Knife	4	—	—	4
3.	Engraver	1	—	—	1
4.	Awl	12	2	3	17
5.	Hair-pin	1	—	—	1
6.	Ear-stud	1	—	—	1
7.	Ear-ring	2	—	—	2
8.	Pendant	1	—	—	1
9.	Gamesman	2	—	—	2
10.	Rod	6	—	1	7
12.	Cut-piece	2	—	1	3
13.	Ivory tusk	1	—	—	1
				Grand total	42

[1]In the Louvre Museum, Paris.

6. GOLD OBJECTS

Apart from a large number of micro-beads of gold used in the necklaces Lothal has yielded 110 gold objects of various sizes. The variety of objects used and the artistic skill of the jewellers are evident from the personal ornaments found at Lothal.

A. Source

Gold occurs in India in alluvial deposits and in reefs and veins. There is frequent reference to gold in Vedic literature. Working of gold must have been a very ancient industry as can be made out from the references to gold-mining in the *Arthaśāstra*.[1] The Greek writers have also testified to gold-mining in India. In ancient times gold-washing was an important industry in the beds of the rivers draining the crystalline and metamorphic regions as they carry auriferous sands. The Chota Nagpur Hills and the valleys of the Himalayan rivers are known for gold in small quantities. Extensive gold workings are reported from Singhbhum and Manbhum Districts in the former Gangpur State. Ancient batteries and mortars used for crushing are found in the Chota Nagpur area. Alluvial gold washings are known from the river beds in the Deccan, upper reaches of the Indus and in Central India. The most important source of gold in India from the ancient to the modern times has been the Dharwar rocks where deepmining and open-cast methods were adopted. As many as fifty sites of ancient gold-mining are reported in the former Mysore State area.[2] In the Champion Reefs the old workings are open pits or tunnels and burrows wherein debris and washings and occasionally pottery can be seen. Clusters of old workings are also seen near Kolar, Mysore, Halebid and Gadag in Mysore State, in the Nilgiri Hills and Wynaad of Madras State, and in the Anantapur District of Andhra State. Another group of old working which seems to belong to the protohistoric period is the one in the Hatti area of Raichur district where gold-mining has been resumed recently on a fairly large-scale.

As regards the antiquity of mining the archaeological evidence consists of the black-and-red ware and burnished grey ware from the old workings of the Champion Reefs area, which Dr. M. H. Krishna considered as belonging to the pre-Christian era. Some of the sherds lying in the office of the Geological Survey of Mysore, Bangalore and in the Department of Archaeology, Mysore examined by the author show unmistakble affinity with the burnished grey ware of the Neolithic settlements such as Tekkalakotta,[3] and Banahalli in Mysore and Paiyampalli in Tamilnadu. The hammerstones and pounders found near the old workings closely resemble those from the Neolithic settlements. It is therefore highly probable that initially the Neolithic folk worked the gold-bearing deposits and their contact with the Harappans may be the result of trade in gold, steatite and other products of the mineral-rich areas. The earliest datable evidence from the Hutti mines is in the form of wood from the Oakleys-shaft. The Carbon-14 date for the wood specimen is 1890±70 years. Other evidences adduced by Allchin[4] also confirm that the the shaft was worked as deep as 250 ft. in the opening years of the Christian era. The exposures of gold-bearing rocks must have been smashed by fire-setting in the Neolithic

[1] *Arthaśāstra*, III, 13.

[2] *Bulletin of the Department of Mines and Geology, Mysore* (1916).

[3] M. S. Nagaraja Rao and K. C. Malhotra, *The Stone Age Hill-dwellers of Tekkalkota* (Poona 1965) p. p. 47 ff.

[4] F. R. Allchin—'Upon the Antiquity and methods of Gold Mining in Ancient India' in the *Journal of Economic and Social Hhistory of the Orient* (1962), Vol V, pl. II. pp. 195-211.

area. Munn has reported several large stones used for crushing and rubbing rnea Masi,k Piklihal etc.

The analysis of the gold from Lothal has revealed natural alloy, electrum, with a high percentage of silver and free from lead used by the goldsmiths in making pendants and other ornaments. The Archaeological Chemist who has analysed the specimens is of the view that alluvial gold was not used by the Lothal folk (below p. 664 *ff.*).

An important evidence in favour of the theory of the Neolithic folk working the gold mines in Kolar area is the occurrence of the burnished grey ware and the black-and-red ware in the old shafts of the Champion Reefs. Both these ceramic wares are found at Paiyampalli, a Neolithic settlement in the North Arcot District of Tamilnadu situated 40 miles away from the Kolar Gold-mining area and about 50 miles from the ancient workings near Hosur in Tamilnadu. Tekkalakotta and Piklihal have also yielded burnished grey ware along with gold objects. Mention has already been made of other evidences of contact such as steatite disk-beads and carnelian beads characteristic of Harappan settlements occurring in the Neolithic sites.

B. Technique

Thin foils and beads of gold found at Lothal suggest that sheet-metal was beaten into foils. Casting was also widely practised. The goldsmiths must have possessed adequate skill and knowledge of metallurgy. Joining was done either by sweating or soldering. In the case of beads the midrib concealed the joints. Controlled heating was also applied for joining. The use of copper as an alloy for soldering between the spirals of coiled gold rings clearly suggests the use of an alloy. Conical objects and rings of gold were joined by sweating.

C. Ornaments

The high degree of precision, uniformity and control noticed in fashioning gold-jewellery reveal a mastery over the technique comparable only with that of Sumer. The minute barrel-shaped and circular beads reveal the unerring control the jewellers had in fashioning minute objects. The bead No 387 has facets at one end produced by hammering while the other was finished smooth by grinding or filing. An example of expertise in applied decoration is seen in jasper bead No. 1114 (pl. CCXCVI A, *13*) bordered with a gold cap at both the ends. Gold-capped beads occur in Mohenjo-daro and Minoan II[1] also. A carnelian bead with gold cap is reported from the Sargonid period at Kish.[2] The great economy exercised in using the precious metal is attested by the process of laying thin foils of gold over lac at Lothal as is even now the practice in India. In Ur gold foil was used on bitumen.

A miniature earthen jar recovered from a house contained a large number of minute beads, two hemispherical end-beads and three spacers, all of gold. Two of the spacers have five holes each and the third one has ten. It is evident from this assemblage that gold necklace of ten strands separated by spacers was in use (pl. CCXCV A). The reconstruction is based on the presumption that the ten-holed spacer was used in the centre and the two five-holed spacers one on each side. The D-type beads were used as terminals. The type of necklace reconstructed on the basis of the spacers and terminal is still used by the women in Gujarat. The Royal Cemetery at Ur has also yielded similar spacer beads of gold with holes varying in number from three to ten.

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[1]Noticed by the author in the National Museum at Athens.

[2]Mackay: 'Furthe links between Ancient Sind, Sumer aud elsewhere' in *Antiquity* V (1931) pp. 459-73.

Hollow-cones or conical caps, as Marshall has called them, of varying sizes in gold were found at Lothal (pl. CCXCV B). They appear to have been used as head-ornaments suspended with a hook from the forehead, the hook being secured by a string or a lock of hairs. These cones could also be used as ear-ornaments. The conical cap was made without soldering by beating out a thin plate of gold and stiffening it by bending the edge at right angles. A loop-ring is soldered inside at the pointed end. Harappa and Mohenjo-daro have also yielded gold conical objects of the type described above. A thin circular (disk) plate of gold with two perforations (pl. CCXCV B) on the margin comes from the altar on which an animal was sacrificed in the Lower Town at Lothal. A similar ornament or amulet is depicted on the head of the stone-statuette of a priest from Mohenjo-daro. In view of the fact that the gold disk from Lothal was found along with charred animal remains and carnelian beads in the altar it is reasonable to assume that it was worn by the priest or sacrificer and corresponds to the *rukma* worn by the *hotr*, performing sacrifices. Or else it might have been used as an amulet after the rites were over. In the latter case it was threaded in a necklace and therefore imparted with some mystical meaning. On circumstancial evidence it can be assumed that it was worn by someone while performing an animal sacrifice.

Another important find from Lothal is a gold-ring with a corrugated surface produced from a gold-sheet. Similar rings are worn even today by the bride and bride-groom in the marriage ceremony.

Solid disk beads with axial tubes found in a merchant's house at Lothal are comparable with those from Ur. Two of them having double axial tubes appear to have served the purpose of spacers. The beads were formed by beating together two thin plates over one or more rods placed in the centre. The edges are so carefully joined by slow hammering. All the disks with axial tubes might have been strung together into a necklace (pl. CCXCVI B).

A gold cylindrical pin (No. 117521) (pl. CCXCVI A, *11*) with an ovoid eye at the tapering end was probably suspended from the middle or upper part of the ear. Similar earpins with decorated beads are used even now in India. The gold needles referred to by Marshall resemble apin from Lothal.

A hollow conical ornament with a loop ring meant for suspension was used as a head-ornament. Similar ones occur in copper and terracotta also (above p. 515).

Pl. CCXCV A

1. Necklace, gold, reconstructed by using the micro-barrel, beads spacers and terminals found in a pot. From phase IV Period A. (No. 3172).

Pl. CCXCV B

1. Ear-ornament; hemispherical foil with a loop ring inside meant for suspension. Damaged. From phase III, Period A. (No. 15262).
2. Ear-ornament; conical foil with a loop-hook at the inner apex; damaged. From phase III, Period A. (No. 14784).
3. Ear-ornament; crumpled; probably a hollow cone with a hook at the apex on the interior. From phase IV, Period A. (No. 13339).
4. Indeterminate shape; unstratified. Period A. (No. 12150).
5. Ear-ornament, a solid conical pin with a small elliptical eye at the tapering end meant for suspension. From phase III, Period A. (No. 11752).
6. Bead; barrel, circular; Damaged. From phase II, Period A. (No. 5093).
7. Inlay piece, thin foil with biconvex sides. From phase IV, Period A. (No. 793). Similar inlay pieces are found in shell also.

Pl. CCXCVI A

1. Micro-beads stringed together. From phase IV, Period A. (SRG 1 976).
2. Bead; short, barrel, circular, edges damaged. From phase III, Period A. (No. 8838).
3. Bead; as above. From the cemetery. From phase V, Period B. (No. 13648).
4. Bead; short, cylinder, circular, From phase III, Period A. (No. 517).
5. Bead; short barrel, circular. Damaged. From phase, Period A. (No. 13370).
6. Amulet; folded foil with axial tube; From phase III, Period A. (No. 13277) Rectangular.
7. Bead; short barrel, circular. From phase IV, Period A. (No. 11616).
8. Bead; short bicone, circular. From phase IV, Period A. (No. 8751).
9. Bead; disk, circular with axial perforation, Damaged. From phase III, Period A. (No. 14165).
10. Bead; cylinder, circular. Damaged. From phase III, Period A. (No. 1163).
11. Bead; short, bicone, circular. Damaged. From phase III, Period A. (No. 12029).
12. Bead; Jasper with gold cap on either side; short, barrel, elliptical. From phase, Period A. (No. 1114).
13. Bead; short, cylinder, circular—Edges bevelled. From phase IV, Period A. (No. 9542).
14. Bead; Short cylinder, hexagonal faceted. From phase III, Period A. (No. 387).
15. Bead; barrel, circular. From phase II, Period A. (No. 480).
16. Bead; bicone, circular (disc). From phase III, Period A. (No. 5039).

Pl. CCXCVI B

1-9. Beads; standard, circular (disk), with axial tube. No. 9 has two axial tubes. Gold sheets are beaten together to form beads. From phase III. From period A. (No. 15118a—i). Occur in the Royal Cemetery at Ur.[1]

10. Pendant; circular disk with two transverse perforations at the top, Damaged. From phase II, Period A. (No. 2696).

11. Ear-ornament; hollow cone with conical decorated border; Damaged. From phase IV, Period A. (No. 15117).

12. Ear-or head-ornament, disc, made of a very thin foil. From phase III, Period A. (No. 14784).

13. Head-ornament, hollow cone with a perforation at the apex; bevelled edge. From phase IV, Period A. (No. 3275).

14. Ring, standard, cylinder, circular, corrugated on the interior as well as exterior. From phase III, Period A. (No. 15115).

Table XXV

Sl. No.	Nomenclature	Period		Unstratified
		A	B	
1.	Beads	39	—	5 (excluding micro- beads)
2.	Conical ear-ornaments	5	—	—
3.	Ear-pendant	1	—	—
4.	Nose ornament	1	—	—
5.	Head Ornament	1	—	—
6.	Disk	10	—	—
7.	Micro-bead necklace	—	—	1
8.	Foils	10	4	5
9.	Pieces	18	3	3
		Grand total		110

[1]Woolley. II, *op. cit* II 1939.

CHAPTER XXIII

ANIMAL REMAINS FROM LOTHAL EXCAVATIONS

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1. INTRODUCTION

This report deals with the animal remains collected from Lothal Excavations during the field seasons of 1955-60.

The total number of bones recovered from Lothal is very large and most of them are fragile and fragmentary in nature. The organic meterial of the bones has disappeared and they are impregnated with organic material. Some intact and well preserved bones such as vertebrae, cannon bones, carpal and tarsal bones and phalanges have also been recorded. Not even a single complete skull is present among the remains. A number of fragments of this collection which are of no help for identification have been rejected.

The Lothal collection consists of four thousand eight hundred and sixty identified animal remains, represented by 31 species of animals which include 6 invertebrates and 25 vertebrates.

A. Invertebrates

1. *Viviparus bengalensis* (Lamarck) race *mandilensis* Kobalt.
2. *Pila globosa* (Swainson).
3. *Telescopium telescopium* Linnaeus.
4. *Olivia ispidula* Lamarck.
5. *Xancus pyrum* Linnaeus.
6. *Conus* (Rhizoconus) *rattus* Bruguiere.

B. Vertebrates

1. *A carp Fish.*
2. *Rita rita* (ham. Buch)
3. *Lissemys punctata* (Bonnaterre) forma *typica*
4. *Chitra indica* (Gray).
5. *Gallus* sp.
6. *Canis familiaris* Linnaeus.
7. *Canis aureus* Linnaeus.
8. *Herpestes auropunctatus* Hodgson.
9. *Elephas maximus* Linnaeus.
10. *Equus caballus* Linnaeus. m
11. *Rhinoceros unifornis* Linnaeus.
12. *Sus scrofa cristatus* Wagner.
13. *Mumtiacus mumtzak* Zimmarmann.
14. *Axis axis* Erxleben.
15. *Cervus unicolour*Kerr.
16. *Cervus duvauceli* cuvier.
17. *Boselaphus tragocamelus* Pallas.
18. *Bos gaurus* H. smith.
19. *Bubalus bubalis* Linnaeus.
20. *Bos indicus* Linnaeus.
21. *Antelope Carvicapra* Linnaeus.
22. *Capra hircus aegagrus* Erxleben.
23. *Ovis orientalis vignei* Blyth.
24. *Lepus nigricollis* Cuvier.
25. *Rattus rattus* Linnaeus.

These animal remains in general resemble in their species with those of Harappa (Prashad, 1936), Mohenjo-daro (Sewell and Guha, 1931), Hastinapur (Nath, 1954-55) Rupar (Nath, unpublished) Anau (Durest, 1908) Sialk (Ghirshamann, 1939) and Shahtepe (Amschler, 1931).

The majority of the remains are of domestic animals, the *Bos indicus* being the most predominant. The finds of *Bubalus bubalis* are much less compared to the *Bos indicus,* thereby indicating that the Lothal inhabitants did not maintain large herds of buffalos.

The remains of sheep and goats are fairly large in number. The finds of the domestic pig are also quite large in number.

A few remains of dog are also present. The remains of Lothal dog are much akin to the pariah dog now found in India. Some finds of the jackal have also been recorded and this indicates that this animal frequented the outskirts of Lothal haibtational site.

The finds of mangoose and rat recovered from Lothal suggest their presence in the the habitational site.

The single find of horse indicates the existence of this animal at Lothal during the Harappan times. The terracotta figure of horse recovered from Lothal synchronizes with the actual find of the horse at Lothal.

Another interesting find at Lothal is one Rhinoceros's bone which reveals the presence of this animal during those times and thereby indicating a humid and moist climate as compared to the present dry-sandy climate. This species is no longer found there and has become extinct.

Some remains of domestic fowl recorded at Lothal resemble the modern domestic specimens. This evidently shows that those people were maintaining poultry also.

The remains of fish and reptiles are also found. The reptillian finds are of *Chitra indica* and *Lissemys punctata* and the fish remains are of *Rita rita* and teleost fish.

Among the wild animals three members of the deer family viz. *Cervus duvaucelli* (Barasingh), *Cervus unicolor* (Sambar) and *Muntiacus muntazak* (Barking deer) are represented. The remains of two wild bovines viz. *Boselaphus tragocamellus* (Nilgai) and *Antelope cervicapra* (Black buck) are also recorded.

The presence of these wild species indicate the existence of some forest in the vicinity of Lothal habitational site.

As in the case of Anau (Duerst, 1908), Mohenjo-daro, Harappa, Hastinsapur, Maski and Rupar there is a large number of bones of young animals at Lothal also, signifying that the people practice fullfledged domestication.

A few bones particularly of *Bos indicus,* sheep, goat and the pig have definite cut marks by sharp instruments which show that the people probably used these animals for food purposes.

2. SYSTEMATIC ACCOUNT OF THE ANIMAL REMAINS

A. Invertebrata

Phylum	Mollusca
Order	Mesogastropoda
Family	Viviparidae

Viviparus bengalensis (Lamarck) race *mandilensis* Kobalt (The Banded Pond-snail)
Material : One hundred and thirteen complete shells, out of which one shell SRG 2; Locus B9; Stratum 19 and the rest from SRG 2; Locus P × 21; Stratum 10; depth 6'10".

All these shells of the Banded Pond-snail resemble closely with those of the modern specimens in the Z.S.I. collection and as well as those from Harappa and Mohenjodaro. These species are commonly found in ponds and lakes through out India. The photograph of one of these shells from Lothal is reproduced on Plate No. CCXCVII A, *1*.

Family Pilidae
Pila globosa (Swainson)

Material : One complete shell. From SRG 2; Locus P×21; Stratum 10; Depth 6'.10".
This specimen has been compared with the *Pila globosa* in the Z.S.I. collection and found to resemble closely. Its photograph is reproduced on No. CCXCVII A, 2.

Family Potamididae
Telescopium telescopium Linnaeus

Material : Two incomplete shells. From SRG; Locus P3; Stratum 7 and SRG 2; Locus B 10; Stratum Pit by 12.
The two specimens referred above show a close resemblance with the modern specimens *Telescopium telescopium* in the Z.S.I. Collection. A photograph of one of these two shells from Lothal is reproduced in Plate No. I. CCXCVII A, *3*.

Order Stenoglosa
Family Olividae
Olivia ispidula Lamarck

Material : One complete Shell. From SRG 2; Locus E 20; Stratum 2. This shell of *Olivia is-pidula* bears a marked similarity with the modern specimen in the Z.S.I. collection. Its photograph is reproduced on Plate CCXCVII A, *4*.

Family Xancidae
Xancus pyrum Linnaeus
(The Shank Shell).

Material : Forty five fragments of Shank Shells.

Mostly from SRG 2 and SRG 3

The finds of the shank shells although fragments in nature, resemble those from Mohenjo-daro and the specimens in the Z.S.I. collection. Twelve fragments of inner core or columella without the shell covering are also included in this collection. The Sawing of the columella fragments indicates that these shells were used for the manufacture of ornaments such as bangles, rings and other fancy goods. The photographs of the fragments of columella and the outer shell are reproduced on Plate No. CCXCVII A, Fig. No. *5* and *6*.

Family Conidae
Conus (Rhizoconus) *rattus* Bruguiere

Material : One complete shell. From SRG 2, Locus 20; Stratum 21;
It has been compared with the specimen in the Z.S.I. collection and found to resemble closely. Its Photographs is given on Plate No. CCXCVII A, No. *7*.

B. Vertebrata

Class Pisces
Order Teleostei
A carp fish

Material : Twenty three body fragments of vertebrae. All from SRG 2 and SRG 3. These fragments of vertebrae appear to belong to some species of carp but it is difficult to identify them generically as the distinctive features are not wellmarked.

Family Siluridae
Rita rita (ham. Buch)
(A fresh water fish)

Material : One fragment of pectoral spine from SRG 2; Locus C1; stratum Pit sealed by 21. One fragment of pectoral spine. From SRG 2; Locus B 10; Stratum Pit by 2. One fragment of pectoral spine. From SRG 2; Locus B 1 stratum 9. All the three finds resemble closely with those from Harappa (Prashad 1936, P. 12) and Mohenjo-daro (Sewell and Guha, 1931, P. 664).

Class Reptilia
Order Chelonia
Family Trionychidae
Lissemys punctata (Bronnaterre), forma
typica (The Common-Soft-shelled Box Turtle)

Material : One fragment of epiplastron. From SRG 2; Locus 20; Stratum 7.

This specimen is undoubtedly of a medium sized individual of *L. punctata* forma *typica*. It resembles in all pattern and vermiculations with those from Mohenjo-daro (Sewell and Guha, 1931, P. 663) and Harappa (Prashad, 1936, P. 14). The photograph of this Lothal specimen is given on Plate No. CCXCVII A, *8*.

Chitra indica (Gray)
(The River Turtle).

Material : Twenty one fragments of hypoplastron. Mostly from SRG 2 and SRG 3. All these finds of the River Turtle bear a marked resemblance with those from Mohenjo-daro (Sewell and Guha, 1931, P. 6, 63) and Harappa (Prashad, 1936 P 14) in their patterns and vermicullations. A fragment of the hy-poplastron of the Lothal species is reproduced on Plate No. CCXCVII A, *9*.

Class Aves
Order Gallinae
Family Phasinoidae

Gallus Sp

Material : Four fragments of Limb bones viz. Humurus, radius, tibia, tibio-tarsus and tarsometatarsus. Mostly from SRG 2 and SRG 3.

All these fragmentary bones of *Gallus* sp. resemble closely with those from Harappa (Prashad, 1936, P. 15) and the modern specimens in the ZSI. collection. The Mohenjo-daro finds far exceed in size to those of the Lothal specimens.

Some well preserved specimens such as tarso-metatarsus and ribio tartus are illustrated on Plate No. CCXCVII B, *10-11.*

Order Carnivora
Family Canidae
Canis familiaris Linnaeus
(The Domestic Dog).

Material : One distal fragment of left humerus. From SRG 1; Locus XIV-XVIII; stratum 14.

One distal fragment of left humerus. From SRG 2; Locus 13; Stratum Pit sealed by 2.

One fragment of right horizontal ramus of mandible, one proximal fragment of 2nd left metacarpal, one proximal fragment of 2nd right metacarpal and one shaft-fragment of left humerus. From SRG 2; Locus E. 3; Stratum 3.

The above mentioned remains of dog are mostly fragmentary in nature and are more akin in shape, configuration and size to those of Mohenjo-daro, Harappa and Rupar and the modern pariah dog in the ZSI. collection,

The photographs of well preserved distal fragment of left humerus and the shaft fragment of left humerus are illustrated on Plate CCXCVII B, *12* and *13.*

The measurements of the distal fragment of humerus along with that of the modern specimen are given below :—

Measurements (in millimetres)

	Maximum breadth of distal extremity	Maximum breadth of articular surface
Lothal specimen	27·5	27
Z.S.I. specimen	19·5	19·5

It is evident from the above table that the Lothal specimen is close to the modern pariah dog met with in India.

Canis aureus Linnaeus
(The Indian Jackal)

Material : One left calcaneum. From SRG 2; Locus B 5; Stratum 16. One broken lumbar vertebra. From SRG 2; Locus A 28; Stratum Pit by 2.

One proximal fragment of left ulna and a fragment of left horizontal ramus of the mandible. From SRG 2; Locus 15; Stratum 2. resemble closely with those of Harappa and the modern Indian Jackal.

The photographs of the intact specimens of calcaneum and the fragment of horizontal ramus are reproduced on Plate No. CCXCVII B, *14* & *15.*

The presence of the finds of Jackal reveals that these animals were frequenting the Lothal habitational site.

Family Viverridae
Herpestes Auropunctatus Nodgson
(The small Indian Mongoose)

Material : Right ramus of the mandible with broken coronoid process. From SRG 2; Locus A 2; Stratum. One left humerus without distal extremity. From SRG 3; Locus H×8; Stratum Kiln. One right horizontal ramus of mandible From SRG 2; Locus B 6; Stratum 35.

All the above three fragments bear a close resemblance to those of the modern specimens of the small Indian Mongoose in the Z.S.I. Collection.

The fragment of mandible which consists of an intact horizontal ramus with teeth, condyle and coronoid process is illustrated on Plate No. CCXCVII B, No. *16*.

The measurements of this specimen along with that of Harappa and the modern specimen (Z.S.I. collection) are given below.

	Length of horizontal ramus.	Maximum breadth of condyle	Length of teeth row
Lothal specimen	41	7·5	18
Harappan specimen	40	7	18
Modern specimen	51	9·5	23

From the above measurements it is evident that the Lothal specimen is akin to the Harappan and modern specimen.

Order Proboscidea
Family Elephantidae
Elephas maximus Linnaeus
(The Indian Elephant).

Material : Three fragments of right femurii and the 1st phalanx of the 4th digit of right hind limb.

One fragment of radius. From SRG 2; Locus B 20; Stratum 14.

All the above three fragmentary bones and the 1st phalanx resemble closely with their counterparts of the modern specimen of the elephant in the Z.S.I. collection.

The find of the 1st phalanx mentioned above is intact and well preserved and its photograph is reproduced on Plate No. CCXCVIII A, *17*.

Although the finds of elephant are few in number, they however show the presence of elephants at Lothal

Order Perissodactyla
Family Equidae
Equus *caballus* Linnaeus
(The Horse)

Material : 2nd right upper molar tooth. From SRG 2; Locus C · 9; Stratum (2); depth 1'8".

The single tooth of the horse referred above indicates the presence of the horse at Lothal during the Harappan period. The tooth from Lothal resembles closely with that of the modern horse and has pli-caballian (a minute fold near the base of the spur or protocone) which is well distinguishable character of the check teeth of the horse.

The photograph of the horse tooth from Lothal is reproduced on Plate No. CCXCVIII A; *18* and *19*.

The remains iof horse have also been recorded from Mohenjo-daro, Harappa, Taxila, Rupar and Ujjain.

The measurements of the Lothal specimen along with that of the modern horse tooth (Z.S.I. collection) are given below :—

Measurements (in millimeters)

2nd right upper molar tooth	Lothal specimen	Modern specimen
Length of crown	29	23
Width of the crown	25	25
Length of Protocone	12	12
Length from posterior margin of crown to antecrochet	18	15
Length from posterior margin of crown to anterior lobe of protocone	23	20

Family Rhinocerotidae
Rhinoceros unicornis Linnaeus
(The Great One-horned Rhinoceros)

Material : One fragment of the mandible comprising the right horizontal ramus and some portion of vertical ramus. From SRG 2; Locus D×9; Stratum 3.

This solitary find of rhinoceros bears a close similarity to that of the modern one-horned rhinoceros specimen in the Z.S.I. collection.

The photographs of this specimen are illustrated on plat No. CCXCVIII B, *21* and *22*.

Order Artiodactyle
Family Suidae
Sus scrofa cristatus Wagner
(The Indian demostic Pig)

Material : Eight hundred and forty remains of this species have been recorded and these comprise the fragments of skulls, lower jaws, teeth, limbgirdles, limbbones, ribs and vertebrae.

These remains have been recorded from every layer of the Lothal excavations. Most of the finds are fragmentary in nature except some metacarpals and metatarsals bones and few axial bones. Except an incomplete skull of an young animal no adult skull has been recorded.

The photograph of the incomplete skull of the young one is reproduced on Plate No. CCXCVIII A, *20*.

A number of fragments of lower jaws were recovered, some of them bearing teeth. The photograph of a well preserved lower jaw fragment is illustrated on Plate CCXCIX A, *23*.

The loose teeth available do not show any specialised peculiarities but they generally resemble with that of the modern domestic pig in the Z.S.I. collection. The photograph of a tusk (canine tooth) is reproduced on Plate No. CCXCIX A, *24*.

The photograph of intact and well preserved At-las vertebra is given on Plate No. CCXCIX A, *25*.

The limb bones area mostly fragments but some intact bones such as astragalus, calcaneum, metacarpals and metatarsals are also present. The photographs of calcaneum, astragalus and 4th metacarpal bones along with fragment of the humerus bone are illustrated on Plate No. CCXCIX A, *26* to *29*.

The occurrence of a large number of bones of the pig in the entire collection of Lothal animal remains indicates that this animal was one of their favourate domestic animals next to *Bos indicus*.

Family Cervidae

Muntiacus mumtzak Zimmermann

(The Barking Deer)

Material : One fragment of rib. From SRG 2; Locus C.21; Stratum 5. One proximal fragment of tibia. From SRG 3; Locus E×8; Stratum Pit by 5.

These two available fragments of the barking deer resemble closely with those of the modern specimen in the Z.S.I. collection.

A photograph of the promixal fragment of tibia is illustrated on Plate No. CCXCIX B, *30*.

Axis axis Erxleben

(The spotted Deer).

Material : Eleven fragments belonging to mandible, limb-girdles and limb bones and two intact bones of astragalus and 1st phalanx. From SRG 2; SRG 3; and SRG 5.

The above mentioned remains of the spotted deer are mostly fragments except two intact bones viz. the 1st phalanx and the right astragalus. All these finds show marked resemblance to those of the modern specimen in the Z.S.I. Collection.

The photographs of well preserved 1st phalanx and astragalus are illustrated on Plate No. CCXCIX B *31* and *32*.

The presence of the remains of this animal has also been recorded from Mohenjodaro, Hastinapur, Brahmagiri and Nagda.

Cervus unicolor Kerr

(The Sambar)

Material : Two fragments of upper molar teeth and one fragment of lower molar tooth. From SRG 1; Locus XIV-XVIII; Stratum 14. One fragment of 3rd left lower molar tooth. From SRG 2; Locus C 24; Stratum 6: Depth 6′6″.

One 3rd left lower molar. From SRG 2; Locus J 10; Stratum 3;

One fragment of right horizontal ramus of mandible with 3rd molar. From SRG 2; Locus B 13; Stratum 4.

One 2nd left lower molar. From SRG 2; Locus B 32; Stratum 3.

One proximal fragment of left scapula. From SRG 2; Locus C×9; Stratum 3; Depth 3′6″.

One 2nd phalanx. From SRG 2; Locus E 13; Stratum 7. Except a couple of molar teeth and the 2nd Phalanx all the rest of the finds of this animal are fragmentary in nature. The lower jaw ramus is imcomplete but it resembles in all respects with that of the recent specimen in the Z.S.I. collection. The photograph of this specimen is illustrated on Plate No. CCXCIX B, *33*.

The Sambar has also been reported from Mohenjo-daro, Nagda and Rupar.

Cervus duvauceli Cuvier

(The Barasingha)

Material : One antler fragment. From SRG 2; Locus B 28; Stratum 5; Depth 1'5".

The single antler fragment of the Barasingha bears a marked resemblance with the modern specimen in the Z.S.I. collection. Reproduced on Plate No. CCXCIX B *34*.

Order Artiodactyla

Family Rovidae

Boselaphus tragocamelus Pallas

(The Nilgai)

Material : Nine fragments belonging to maxilla, teeth, limb bones and two intact bones of astragalii and one 1st phalanx. From SRG 2, SRG. E.

Except the two astragalii and the 1st phalanx all the rest of the remains of this animal referred above are fragments, but they show a marked similarity to that of the modern specimen of the Nilgai in the Z.S.I. collection.

The photographs of well preserved and intact specimens of left astragalus and 1st phalanx are illustrated on Plate No. CCXCIX B, *35* and *36*.

A few teeth of this animal available bear a marked resemblance with that of the modern specimen.

The limb bones which are all fragments are not suitable for taking measurements.

The remains of this animal have also been recorded from Nagarjunakonda.

Bos gaurus H. Smith

(The Indian Bison)

Material : One fragment of right horizontal ramus of mandible with 2nd and 3rd molars and a distal and fragment of left 3rd and 4th metacarpal. From SRG 2; Locus D×9; Stratum 3.

One 3rd left lower molar. From SRG. 2; Locus B 6; Stratum 22. One fragment of right scapula with glenoid cavity and some portion of neck and one fragment of the body of thoracic certebra. From SRG 2; Locus D 5; Stratum 3.

Most of these finds show a close resemblance to those of the modern specimen of the Indian Bison in the Z.S.I. collection. The available teeth and the mandible fragment, though incomplete, bear a marked similarity to the modern specimen. The photograph of the mandible fragment is reproduced on plate No. CCXCIX *37*.

Bubalus bubalis Linnaeus

(The Indian Buffalo).

Material : Two hundred and one remains belonging to the animal have been recorded. These finds include some intact and well preserved bones of limbs such as astragalus, calcaneum, phalanges, tarsal and carpal bones and vertebrae. Some teeth are also available. A large portion of the remains are fragments of limb-girdles, limb bones, lower jaws, teeth vertebrae and ribs.

The finds of buffalo have been recorded almost from all the layers at Lothal.

Unfortunately not even a single skull of this species has been recorded. The available teeth do not show any specialised peculiarities but generally resemble those of the recent domestic buffalos of India.

The photographs of some of the intact and well preserved bones such as Axis vertebra, scapho-cuboid, calcaneum and 1st phalanx are reproduced on Plate No. CCCA *38* to *41*.

The remains of this animal from Lothal show a close structural resemblance with that of the modern domestic buffalo in the Z.S.I. collection. They are also similar to those of Mohenjodaro (Sewell and Guha, 1931, P. 659), Harappa (Prashad 1936, PP. 43-44), Hastinapur (Nath 1955, P. 150), Maski (Nath, 1957, P. 126) and Rupar (Nath, unpublished report).

Bos indicus Linnaeus

(The Zebu or the Domestic Humped Cattle of India)

Material : Altogether two thousand five hundred and ninety two bone remains of this animal have been recorded from the Lothal excavations. These include fragments of skulls, mandibles, limb-girdles, limb-bones, vertebrae and ribs.

The finds of the *Bos indicus* have been recorded from all the layers of Lothal excavations. The very frequency with which the finds of the *Bos indicus* are met with in this excavation indicates that the inhabitants used to maintain large herds of this animal. In number of cases the remains are of young ones thereby revealing that the Lothal people had practised full-fledged domestication and thus it clearly shows that *Bos indicus* was their favourite domestic animal. The cut marks on some of the bones indicate that this animal was slaughtered for food purposes.

The Photographs of certain well preserved specimens such as astragalus, calcaneum and 3rd and 4th metatarsal are reproduced on Plate No. CCCA *42* to *44*.

The measurements of some well preserved and intact bones of this Lothal species are given below along with those of Harappa and modern specimens.

Measurements (in millimeters)

	Lothal	Harappa	Modern specimen (Z.S.I. collection)
Cancaneum :			
i. Maximum Length	143	144	128
ii. Maximum Breadth of the body			
Astragalus :			
i. Maximum Length	75	77	70
ii. Maximum Breadth of the body	43	47	41
3rd and 4th metatarsal :			
i. Maximum Length	243	268	254
ii. Breadth of the proximal extremity	54	55	45
iii. Breadth at the distal extremity	60	65	44

Antelope cervicapra Linnaeus

(The Blackbuck)

One fragment of horn. from SRG 2; Locus C 28; Straum 5.
One fragment of horn. From SRG 2: Locus D 23; Stratum 5.
One fragment of horn. From SRG 2; Locus A×1; Stratum 8.

These three horn fragments of the Blackbuck have been compared with the specimens of the modern species of the Antilope cervicapra in the Z.S.I. collection and they are found to resemble them closely.

The photograph of one of these fragments of horns is illustrated on Plate CCC B, *45*.

Capra hircus asgarus Erxleben

(The Indian Domestic Goat)

Material : Four hundred and fifty three bone remains of this species have been recovered. These include mostly the fragments of limb-girdles, limb bones, skull, lower jaws, vertebrae and ribs. All these remains have been recovered from almost all the layers at Lothal.

The lower jaws are all incomplete but in general they resemble closely with thse of the modern domestic goat in the Z.S.I. collection. The photograph of a well preserved lower jaw fragment is given on Plate CCC B No. *47*.

The available teeth do not show any marked differentiation and in general resemble with the teeth of the modern specimen.

. The photographs of some well preserved specimens such as horn core fragment, distal fragment of humerus and calcaneum are illustrated on Plate No. CCCB No. *46*, *48*, and *49*.

The remains of goat from Lothal show a marked resemblance to those of Harappa, Hastinapur and Rupar.

Ovis orientalis vignei Blyth

(The Indian Domestic sheep)

Material : Four hundred and eighty eight remains of this animal have been recorded and they include mostly fragments of lower jaws, limb girdles, limb bones, vertebrae and ribs. Some intact bones such as astragalus, calcaneum and vertebrae have also been recorded.

These finds are frequently met with in all the layers at Lothal. Not even a single complete skull is present. The lower jaws are incomplete but in all respects resemble closely with those of the modern specimens in the Z.S.I. collection. The photograph of a well preserved lower jaw fragment is reproduced on Plate No. CCC B, *51.*

The few teeth available do not show any specialised peculiarities but in general resemble closely with those of the modern sheep.

The very few horn cores recovered are incomplete. The photograph of one of the horn core fragments is illustrated on plate No. CCC B, *50.*

As already mentioned above the limb bones are mostly fragments. The photograph of an intact and well preserved radius is reproduced on Plate No. CCC B, *52.*

The measurements of some well preserved and intact bones i.e., radius and astragalus are given below along with those of modern specimens in Z.S.I. collection.

Measurements (in millimeters)

		Lothal	Modern
1. Radius :			
	i. Maximum length	143	143
	ii. Maximum breadth of the proximal extremity	30	31
	iii. Maximum breadth of the distal extremity	26	29
2. Astragalus :			
	i. Maximum length	26	28
	ii. Maximum breadth of the body	17	18

The remains of sheep from Lothal closely resemble those from Harappa, astinapur and Rupar.

Order Lagomorpha

Family Leporidae

Lepus nigricollis Cuvier

(The Indian Hare)

Material : One fragment of the shaft of femur. From SRG 2; Locus B 24; Stratum 3.
One fragment of left tibia. From SRG 2; Locus E 1; Stratum 4.
One fragment of left pelvis. From SRG 2; Locus A 5: Atratul 11.

The finds of this species closely resemble with those of the modern Indian Hare in the Z.S.I. collection.

The photographs of the fragment of left pelvic bone is reproduced on Plate No. CCC B No. *53.*

Order Rodentia

Family Muridae

Rattus rattus Linnaeus

(The House Rat)

Material : One fragment of right femur bone without distal epiphysis. From SRG 3; Locus E×9; Stratum 6.
Two distal fragments of femur bones. From SRG 2; Locus C1; Stratum 4.
The agove mentioned few remains of the rat are mostly fragmentary in nature and resemble with the specimens from Mohenjodar, Harappa and the modern specimens (Z.S.I. collection.).

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4. EXPLANATION OF PLATES

Pl. CCXCVII A

Viviparus Bengalensis (Lamarck) rack *Mandilensis* Kobalt

1. One complete shell—From SRG. 2.

Pila globosa (Swainson)

2. One complete shell—From SRG 2.

Telescopinm telescopium Linn.

3. One broken shell—From SRG 2.

Olivia ispidula Lamarck.

4. One complete shell. From SRG 2.

Xancus pyrum Linn.

5. Fragment of Columella—From SRG 2.
6. Fragment of outer shell—From SRG 2.

Conus (Rhizoconus) *Rattus* Bruguiere.

7. One complete shell—From SRG 2.

Lessemys punctata (Bonnaterre), forma *typica*

8. Fragment of epiplastron. From SRG 2.

Chitra Indica (Gray).

9. Fragment of hypoplastron—From SRG 3.

Pl. CCXCVII B
Gallus Sp.

10. Distal fragment of tarsometatarsus—From SRG 2.
11. Proximal fragment of tibiotarsus—From SRG 2.

Canis familiaris Linn

12. Distal fragment of Left humerus—From SRG 2.
13. Shaft of left humerus without distal and prioximal ends. From SRG 2

Canis Aureus Linn.

14. Left calcancum—From SRG 2.
15. Fragment of left horizontal ramus of mandible. From SRG 2.

Herpestes auropunctatus Hodgson.

16. Right lower jaw (broken)—From SRG 2.

Pl. CCXCVIII A
Elephas maximus Linn.

17. Ist phalaux of the 4th digit of hind limb—From SRG 2.

Equus Caballus Linn

18 Lingual view of second right upper molar—From SRG 2.
19 Buccal view of the same.

Sus Scrofa Cristatus Wagner

20. Dorsal view of the incomplete skull of an young one. From SRG 2.

Plate CCXCVIII B
Rhinoceros univotnid Linn

21. Fragment of right horizontal ramus of mandible (Lateral view).
22. Medial view of the same.

Plate CCXCIX A
Sus Scrofa cristatus Wagner

23. Fragment of right horizontal ramus of mandible From SRG 2.
24. Fragment of right upper tusk—From SRG 2.
25. At-las vertebra—From SRG 2.
26. Right Calcaneum—From SRG 2.
27. Right astragalus—From SRG 2.
28. Left 4th metacarpal—From SRG 2.
29. Distal fragment of left humerus—From SRG 2.

Plate CCXCIX B
Muntiacus muntazak Zimmermann

30. Prozimal fragment of right tibia—From SRG 2.

Axis axis Erxl

31. First phalaux—From SRG 2.
32. Right astragalus—From SRG 2.

Cervus unicdor Kerr.

33. Fragment of right horizontal ramus from SRG 2.

Cervus duvaculi Cuvier.

34. Fragment of antler—From SRG 2

Boselaphus tragocamelus Pallas.

35. Left astragalus—From SRG 2.
36. Ist phalanx—From SRG 2.

Bos garus H. Smith.

37. Fragment of right horizontal ramus From SRG 2.

Plate CCC A

38. Axis vertebra—From SRG 2.
39. Right scaphacuboid bone..From SRG 2.
40. Right calcaneum—From SRG 2.
41. First phalanx—From SRG 2.

Bos indicus Linn.

42. Left 3rd and 4th metatarsal—From SRG 2.
43. Right calcaneum—From SRG 2.
44. Right astragalus—From SRG 2.

Plate CCC B

Antilone Cervicapra Linn

45. Fragment of horn—From SRG 2.

Capra hircus aegagrus ers

46. Fragment of horn—From SRG 2.
47. Fragment of right horizontal ramus—From SRG 2.
48. Distal fragment of right humerus—From SRG 2.
49. Right calcaneum—From SRG 2.

Ovis orientalis Vignei Blyth.

50. Horn—From SRG 2.
51. Fragment of left horizontal ramus—From SRG 2.
52. Left radius—From SRG 2.

Lepus nigricollis Cuvier

53. Fragment of left pelvis—From SRG 2.

CHAPTER XXIV

Report on the Chemical analysis and examination of metallic and other objects from Lothal by Dr. B. B. Lal, Archeaological Chemist

1. COPPER AND BRONZE OBJECTS

A. First Lot

Twelve metallic antiquities were received in this laboratory for chemical examination and analysis. These important metallic antiquities comprised a wide variety of objects such as mirror, axe, celt, ingot, bangle, chisel, fish-hook and arrow-head. All these specimens were subjected to detailed chemical analysis, and the results of analysis are incorporated in the attached table.

The results have been tabulated as they were obtained by chemical analysis, and no attempt has been made to calculate the proportions of different metals in the specimens on the assumption that the specimens contained 100% metal and that no oxygen or insoluble matter was originally present. There is no doubt that in the course of oxidation, corrosion and mineralisation, some metals have been altered, removed or concentrated and part of the metal content has been replaced by siliceous and clayey matter and the corrosion products of the metals originally present.

Before chemical analysis the specimens were freed from corrosion products so far as possible and sound metallic cores were analysed where available. The amount of each metal was calculated and the total of the different proportions of the metals substracted from 100 to give by difference, oxygen and carbon-di-oxide etc., present in each specimen.

Most of the specimens were considerably oxidised and were covered with siliceous and clayey matter and the products of corrosion. Carbon dioxide and soluble chlorides could be detected in most of them.

Whether the amounts of different metals should be calculated on the assumption that originally the metal/alloy of the objects was unoxidised and uncorroded or only the determined values should be shown is a matter of choice. In the present case, the analysis have been given without recalculation of the proportions of different metals on the assumption that originally 100% metal was presept.

From the analytical data shown in the table, it is observed that four specimens contain appreciable amounts of tin. The mirror (No. 15030) contains 5·47% of tin and it, therefore, represents a low tin bronze, free from lead, nickel and zinc. Only traces of iron are present.

The copper rod with grooves (No. 13886) contains 9·02% of tin. Whereas one copper bangle (No. 12143) contains 11·20% of tin. Similarly one chisel (No. 11893) has been found to contain 9·62% of tin. It is thus seen that bronze was used for the manufacture of artifacts such as mirrors, rods, bangles, and chisels. It is also observed that although one bangle and one chisel contain a high proportion of tin, the other bangle and the other chisel do not show the presence of tin.

All these specimens contain traces of iron as an impurity; only one bangle (No. 1344) contains 2·14% of iron. Moreover all the specimens are free from zinc and lead, except specimen No. 10918 (copper axe with sleeves) which has been found to contain 2·51% of lead.

Of the twelve specimens (serial No. 1-12), eleven contain traces or appreciable amounts of nickel; only one specimen (mirror, Sr. No. 15030) is free from nickel. Three of these specimens contain nickel ranging from 0·19% to 0·45%.

Most of these specimens were heavily corroded and oxidised and the presence of appreciable amounts of insoluble matter-siliceous residue insoluble in acids-is indicative of the considerable mineralization which the antiquities had undergone because of prolonged burial in the soil.

The so-called bronze ingot (No. 14535) has turned out to be made of pure copper, containing 99·81% of metallic copper. It was found in an excellent condition free from corrosion, oxidation and mineralization. Only traces of iron and nickel have been detected as impurities.

None of these twelve specimens of copper and bronze has been found to contain arsenic. This is significant, since the copper and bronze objects found in the Indus Valley have invariably been found to contain arsenic. The total absence of arsenic from these copper and bronze objects, therefore, indicates that the raw materials used for the manufacture of these artifacts at Lothal differed markedly from those used in the Indus Valley, and therefore the sources and origins of these must necessarily be different.

Another important point which emerges from the analytical data is that although bronze, both low tin and full-tin, was in use at Lothal, it is difficult to say whether the use of tin was intended to produce a harder metal than copper which was to be used for production of tools with keen cutting edges, or tin was used just to produce an alloy of a more pleasing colour and lustre. The examination of the two chisels shows that whereas one contains a high proportion of tin viz., 9·62%, the other is completely free from it. If the use of bronze for producing tools with a keen cutting edge was well understood, it is difficult to explain the presence of tin in one chisel and its total absence in the other. The same statement is true of the two bangles, one of which is made of copper and the other of full tin (11·20%) bronze. It seems that although the use of bronze was understood, it was not used in a systematic manner for the production of special types of artefacts requiring hardness, durability and a sharp cutting edge, but there is no doubt that both copper and bronze were in use.

Copper of a high degree of purity (99·81%) was in use at Lothal. Whether this copper was smelted locally or whether it was imported cannot be definitely stated in the present state of our knowledge, and it is necessary to examine a larger number of copper objects like ingots which have been made of pure copper for arriving at any definite conclusion regarding the source and origin of copper of a high degree of purity.

From the above analytical work, it is concluded that the artisans of Lothal were well conversant with the use of copper and bronze. The use of tin in high proportions, viz., 9·02%, 11·20% and 9·62% in the fabrication of rods, bangles and chisels was probably motivated by other considerations than mere hardness for producing a durable strong cutting edge. It seems that in the case of bangles and mirrors, tin was incorporated in the copper for producing an alloy of lighter shade which could be rubbed to produce the desired shine. Pure copper is a rather soft metal and is easily tarnished and is not suitable for the fabrication of cutting tools, nor can it be used for making durable ornaments and works of art such as bangles and mirrors which are required to be kept shining. It seems for objects of decorative and ornamental value the use of bronze was considered essential from the point of view of durability whereas for tools such as axes and chisels etc., the use of bronze was considered essential from the point of view of strength and durability of the cutting edge. The celt and the axe with sleeves do not contain any tin, nor is tin present in the shaft hole axe. If strength and durability of the cutting edge of tools were the main

consideration for the use of bronze in place of copper, the total absence of tin from these artefacts is not understood.

Most of the copper and bronze objects examined were evidently made by casting; shaping and finishing by hammering would also appear to have been practised. The mirror which is made of a low-tin bronze was probably heated and hammered after casting until it reached the atmospheric temperature; the same can be said of the celt and axes and chisels. The technique of forging was thus practised by he metal workers of Lothal.

The presence of such a high proportion of tin cannot be treated as accidental; it was used for producing a harder metal than copper, and bronze making and working has reached a fairly high degree of technical excellence in those remote times. The simultaneous presence of both copper and bronze objects would suggest a restricted supply of tin.

It has been suggested that in ancient times copper was alloyed with tin with a view to reducing the melting point of the former for easy working. This suggestion does not seem to be applicable to the bronze objects unearthed at Lothal, Mohenjo-daro and Harappa. Tin is generally present in small amounts, most of the objects containing not more than 5% of tin and this amount of tin would not lower the melting point of copper to such an extent as to effect economy in the use of fuel required for melting, nor would it render the alloy so easily feasible as to offer marked advantage to the metal workers in working it. It seems the intention in the use of tin was to impart to copper the properties of durability and comparative freedom from atmospheric oxidation, for it is well kpown that well-burnished bronze objects retain their lustre and shine for a longer period than similarly treated copper objects.

The analysis of the ingot shows that it is made of copper of a high degree of purity viz., 99·81% and is free from tin, lead, zinc and arsenic but contains only traces of iron and nickel. This ingot as found in a very good state of preservation and was not mineralized. It only showed some superficial oxidation and corrosion. The absence of insoluble residue (insoluble in acids) would indicate complete freedom from nineralization. It is significant to observe that metallic copper in a purer state has not been found in any other specimen from Lothal, and hardly a specimen or two from Mohenjo-daro and Harappa can compare favourably with this specimen from Lothal so far as the purity of copper is concerned.

B. Second Lot

The second lot of 1175 metallic objects was received in this laboratory for chemical treatment and preservation. All the antiquities have been chemically treated and preserved and returned. Twenty six specimens were drawn from selected objects of this lot for a detailed chemical analysis. These specimens give a cross-section of the wide variety of metallic artifacts excavated at Lothal and present a general picture of the art of metal-working which had developed considerably at Lothal. Various metallic objects such as fish hooks, arrow-heads, chisels, rods, bangles, ear-rings, pins, awls, needles, bolts, nails, figurines, axes, beads, daggers, spear-heads, knife blades and similar artifacts have been excavated at Lothal in large nos. and in the table appended to this report is given the result of detailed chemical analysis of such twenty six metallic objects.

From the tables we see that of these twenty-six specimens, two represent silver, two lead and the remaining twenty-two specimens represent copper. These results are very significant, since it is established that no tin has been used in the fabrication of these objects and zinc also has not been detected.

It is further observed that of these twentysix specimens, twelve contain only traces of nickel, whereas three of these contain appreciable quantities of nickel which varies from 0·63% to 2·48%; only eleven specimens do not show the presence of nickel. Further it is

Table XXVI

CHEMICAL ANALYSIS OF TWELVE METALLIC SPECIMENS FROM LOTHAL

Sl. No.	Antiquity No. from which Sps. drawn	Description of specimen	CHEMICAL ANALYSIS									
			Copper	Iron	Tin	Lead	Nickel	Zinc	Acid in-soluble residue	Oxygen by differ-ence	Total	Remarks
1.	2	3	4	5	6	7	8	9	10	11	12	13
1.	15030	Mirror	54·78	Traces	5·47	—	—	—	8·17	31·58	100	
2.	10918	Axe with sleeves	96·27	,,	—	2·51	Traces	—	—	1·22	100	
3.	5957	Celt	97·18	,,	Traces	—	0·31	—	1·34	1·17	100	
4.	13886	Rod with grooves	57·75	,,	9·02	—	Traces	—	3·31	29·92	100	
5.	14535	Ingot	99·81	,,	—	—	,,	—	—	0·19	100	
6.	1344	Bangle	94·90	2·14	—	—	0·45	—	—	2·51	100	
7.	12143	Bangle	74·34	Traces	11·20	—	Traces	—	3·22	11·24	100	
8.	3091	Axe with shaft hole	88·27	,,	—	—	0·19	—	0·79	10·75	100	
9.	11893	Chisel	74·28	,,	9·62	—	Traces	—	3·06	13·02	100	
10.	8110	Chisel	88·53	,,	—	—	,,	—	0·48	10·99	100	
11.	12147	Arrow head	97·21	,,	—	—	,,	—	—	2·79	100	
12.	6040	Fish hook	99·01	,,	—	—	0·28	—	—	0·71	100	

seen that all these twenty six metallic specimens are free from arsenic, which is generally present in most of the bronze and copper objects found at Mohenjo-daro and Harappa.

Of the twentytwo copper specimens, five have been found to contain appreciable quantities of iron which ranges from 0·40% to 4·02%; the remaining seventeen copper specimens generally contain traces of iron and only eight specimens are completely free from iron. This shows that the copper which was used for the fabrication of metallic objects was not completely free from iron and probably a sulphide ore of copper and iron was used for extracting the metallic copper.

These specimens, therefore, do not represent bronze or brass, but they are composed of impure copper containing varying proportions of iron.

As regards two silver specimens, it is observed that silver is considerably contaminated with copper as the two specimens have been found to contain 54·65% of silver and 2·67% of copper and 86·57% of silver and 7·87% of copper respectively, the former specimen containing 3·29% of iron in addition. Apart from contamination with iron and admixture with copper, these two silver objects have been found to be free from lead and only one of of them contains traces of nickel.

Most of the antiquities from which these specimens were drawn were corroded and mineralised to a large extent. It is, therefore, not surprising that most of them have been found to contain a fair proportion of insoluble matter (insoluble in acids); this is an indication of mineralization which has been brought about because of prolonged burial in the soil. Since theses pecimens were highly corroded and oxidised the presence of oxygen in considerable quantities (detected by difference) is only to be expected.

Two specimens have been found to be made of lead; both of them are free from copper, iron, tin, zinc and silver. Nickel has been detected in traces in one lead specimen, whereas the other specimen shows 99·54% of lead. It seems that lead of a high degree of purity (99·54%) was manufactured by the metallic workers of Lothal. Apart from these two specimens of lead, only two copper objects have been found to contain appreciable quantities of lead, which ranges from 0·91% to 1·30%.

The above results would show that the art of metal working was practised on a large scale and the metallic workers of Lothal could manufacture a wide assortment of metallic objects, some of which were of a purely utilitarian character whereas a few others such as ear rings, bangles and other ornaments indicate fairly extensive use of metallic objects of decorative value.

It seems that the raw materials used by Lothal metal workers for the extraction of the metal copper were different from those used at Mohenjo-daro and Harappa, for, otherwise, it is difficult to explain the total absence of arsenic from the copper objects found at Lothal. However, this observation has to be taken with caution in the present state of our knowledge of the metallurgy and metal technology evolved at Lothal, and further analytical work and examination of a large number of metal objects would be necessary to substantiate this tentative suggestion.

C. Third Lot

The third lot of twenty three antiquities was received from Lothal excavations for chemical analysis in this laboratory. This lot consisted of copper objects, such as knives, pins, bangles, engravers, rods, ear-ornaments, fish hooks, anklets, spear heads and scrapers. Most of these objects were fragmentary and considerably mineralised and some represented only fragmentary lumps of non-descript type.

This wide assortment of metallic objects shows that the people of Lothal were considerably advanced in metallurgy and metal working. Silver and gold objects have also

Table XXVII

CHEMICAL ANALYSIS OF METALLIC SPECIMENS FROM LOTHAL

Sl No.	Antiquity No. of which Sps. drawn	Description of Specimens	CHEMICAL ANALYSIS Copper	Iron	Tin	Lead	Nickel	Zinc	Silver	Acid in-soluble residue	Oxygen by difff-erence	Total	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	4280	Lead piece	—	—	—	91·42	Traces	—	—	2·2	6·38	100	
2.	5034	Silver object	2·67	3·29	—	1·64	Traces	—	54·65	3·06	34·69	100	Specimens drawn from antiquities grouped in list—I
3.	10092	Object	—	—	—	99·54	—	—	—	—	0·46	100	
4.	12125	Lump	90·68	4·02	—	—	—	—	—	0·275	5·025	100	
5.	12432	Fragment	72·5	0·95	—	—	2·48	—	—	7·42	16·65	100	
6.	14087	Piece	88·76	Traces	—	—	Traces	—	—	0·58	10·66	100	
7.	4176	Ear ring	7·87	—	—	—	—	—	86·53	2·32	3·28	100	Specimens drawn from antiquities grouped in list—II
8.	4744	Ring	95·31	—	—	—	—	—	—	—	4·69	100	
9.	5373	Spear head	87·34	—	—	—	—	—	—	—	12·66	100	
10.	5578	Fish hook	60·65	Traces	—	1·30	Traces	—	—	5·99	32·16	100	
11.	5971	Bangle or ring	72·95	—	—	—	—	—	—	9·96	17·09	100	
12.	6030	Nail or pin	90·79	Traces	—	—	0·630	—	—	—	8·58	100	
13.	7700	Chisel	90·44	Traces	—	—	Traces	—	—	—	9·56	100	
14.	8480	Spear head	48·26	Traces	—	—	Traces	—	—	13·65	38·09	100	
15.	10842	Dagger or chisel	59·64	0·85	—	—	1·62	—	—	—	37·89	100	
16.	10918	Axe or celt	97·2	—	—	0·91	—	—	—	—	1·89	100	
17.	11971	Figurine	83·31	Traces	—	—	—	—	—	—	13·58	100	
18.	12264	Bangle	72·26	—	—	—	Traces	—	—	7·89	19·85	100	
19.	12378	Axe	70·00	—	—	—	—	—	—	23·00	7·00	100	
20.	12455	Pin	89·95	Traces	—	—	—	—	—	9·01	1·04	100	
21.	13134	Pin	57·76	—	—	—	—	—	—	13·32	28·92	100	
22.	13140	Hook	87·34	0·40	—	—	Traces	—	—	0·78	11·48	100	
23.	14211	Spear head	43·38	0·99	—	—	—	—	—	1·28/3	1751·18	100	
24.	14302	Hook	77·44	—	—	—	—	—	—	—	22·56	100	
25.	14841	Ornament	63·58	Traces	—	—	—	—	—	15·24	21·18	100	
26.	14855	Skeleton ring from double burial	58·36	Traces	—	—	Traces	—	—	13·04	28·60	100	

been found in considerable number at Lothal. Twenty one specimens were examined and analysed.

The results of chemical analysis of these twenty one specimens are tabulated in the attached table.

From the analytical data shown in the table, it is observed that most of the objects are made of copper containing traces of nickel and lead. Iron is also present in some of these specimens. Tin is present to the extent of 13·80% and 11·82% in two specimens; three specimens show a much smaller proportion of tin which ranges from 0·57% to 3·96%. Only two specimens contain a considerably high proportion of iron namely 39·1% and 66·1% and they contain 43·1% and 9·3% of copper respectively. It would thus be seen that the specimen No. 15112 is made of iron containing a small proportion of copper namely 9·3%. In other specimens, iron is present in traces only although in seven specimens it ranges from 0·32% to 0·80%.

Lead is present to the extent of 0·95% in one specimen only; all other specimens are free from lead. No specimen has been found to contain zinc and one specimen No. 15114 has been found to contain 71·20% of silver and 4·13% of copper.

It is interesting to observe that most of these specimens contain traces of nickel and in two specimens nickel is present to the extent of 1·50% and 1·92%. The table shows that of the twenty one specimens fourteen contain traces of nickel and two specimens have been found to contain appreciable quantity of this metal.

Most of these specimens were partially mineralised and considerably oxidised, thus accounting for a fairly high percentage of insoluble siliceous material (insoluble in acids), and oxygen accounts for a considerable percentage, indicating thereby a highly oxidised and mineralised condition of most of these specimens.

It is further observed that silver was also in use and one specimen made of silver (scraper) has been found to contain 71·2% of silver. This object was found to consist of sound metallic core made of silver and the outer layer represented oxidised copper as cuprite.

From the above observation, it is concluded that although bronze was known, the use of this alloy was not extensive and this probably would indicate a scarcity of tin. There is no doubt that the artisans of Lothal had a considerable insight into the technique of metallurgy and metal working and they made use of copper, silver and iron for the manufacture of metal goods. It is significant that gold objects have also been found at Lothal. There is thus no doubt that the use of gold, silver, copper, iron and bronze was fully understood.

All the above specimens from Lothal have been found to be completely free from aresenic and this is significant. It would be necessary to examine a larger number of metal objects from Lothal before a definite opinion can be expressed regarding the origins and sources of the raw materials, metals and alloys used in the manufacture of metallic goods at Lothal.

D. Fourth Lot

A lot of 240 copper objects from Lothal excavations was received in this laboratory for chemical treatment and preservation. The lot comprised a wide variety of objects such as bangles, rings, pendants, ornaments, beads, spacers, talisman, wires, pins, rods, nails, pots lids, fish-hooks, arrow-heads, blades, knives, razors, axes, human and animal figures etc., etc. All of them belong to the same cultural period, namely the Harappa Culture.

TABLE XXVIII

CHEMICAL ANALYSIS OF METALLIC SPECIMENS FROM LOTHAL

Sl. No.	Antiquity No. from which Sps. drawn	Description of specimens	CHEMICAL ANALYSIS									
			Copper	Iron	Tin	Lead	Nickel	Zinc	Ag%	Acid in-soluble residue	Oxygen (by difference)	Total
1	2	3	4	5	6	7	8	9	10	11	12	13
1.	15036	Lump	83·90	0·32	—	—	Trace	—	—	3·32	12·46	100
2.	15196	Lump	72·83	0·55	—	—	,,	—	—	2·53	24·09	100
3.	15176	Handle of knife	46·57	—	—	—	—	—	—	4·2	49·23	100
4.	15208	Pin broken	77·4	0·5	—	—	Traces	—	—	16·2	5·9	100
5.	15155	Pin broken	51·89	Traces	13·80	—	—	—	—	5·40	28·91	100
6.	15251	Lump	57·68	—	—	—	—	—	—	6·94	35·38	100
7.	15169	Fragment	75·6	Traces	—	—	Traces	—	—	0·5	23·9	100
8.	15194	Lump	81·07	0·64	—	—	Traces	—	—	2·55	15·74	100
9.	15209	Bangle fragment	55·32	—	11·82	—	—	—	—	3·89	28·97	100
10.	15211	Lump	43·1	39·1	—	—	1·5	—	—	11·5	4·8	100
11.	15112	Copper fragment	9·3	66·1	—	—	Traces	—	—	17·2	7·04	100
12.	15210	Engraver	70·45	Traces	—	—	Traces	—	—	17·10	12·45	100
13.	15085	Fragment	66·6	0·8	—	—	Traces	—	—	Traces	32·6	100
14.	15137	Rod	60·30	Traces	Traces	—	Traces	—	—	13·44	26·26	100
15.	15139	Ear ornament	48·24	0·70	Traces	Tr	Traces	—	—	16·36	34·70	100
16.	15073	Fragment	59·00	1·56	—	0·95	Traces	—	—	13·11	25·38	100
17.	15063	Fish hook	82·9	Traces	—	—	Traces	—	—	1·2	15·9	100
18.	15079	Engraver	49·64	Traces	3·96	—	Traces	—	—	10·72	35·68	100
19.	15295	Pin 6″ long	96·76	Traces	0·57	—	1·92	—	—	—	0·75	100
20.	15217	Spear or knife	39·07	Traces	2·27	—	Traces	—	—	12·58	36·08	100
21.	15114	Scraper	4·13	Traces	—	—	—	—	71·20	16·29	8·38	100

Twelve specimens were drawn from selected antiquities of this lot and they were subjected to detailed chemical analysis. The results of chemical analysis are tabulated separately.

From the analysis it is evident that all the objects are made of copper. Tin and zinc are absent. It is therefore clear that brass and bronze were not used for making these objects. Most of the specimens show the presence of nickel and in three specimens nickel has been found to be present to the extent of 0·80%, 1·50% and 1·55%. Lead is present in two objects and ranges from 1·51 to 3·60%. Iron is present in traces in nearly all thes pecimens; three of these specimens have however been found to contain 0·61% to 1·00% of iron.

Most of these specimens were highly oxidised and some of them had mineralised considerably.

Among this lot of 240 antiquities were two objects which deserve special mention. One is the figure of a dog (Antiquity No. 237) and the other object (Antiquity No. 220) looks like a human figure. They are tiny objects ranging from 3-4 cms. in length. Mention may also be made in this connection of a revetted copper jar belonging to the same period.

The above results show that this cultural period of Lothal was characterized by a fairly extensive use of copper and that the operation of casting and revetting were well understood. The people of this period possessed considerable skill in working copper and they could manufacture a wide variety of objects. The hand axes found at Lothal possessed a fairly sound metallic core and were substantial copper objects of considerable weight.

The absence of tin in these specimens is significant and seems to point to the rarity of tin. Iron has been found either in traces or in minute amounts in most of the antiquities, but even traces of tin could not be detected in any specimen. Further examination of metallic antiquities from the same cultural period at Lothal would be necessary to solve the problem of use of tin in this period.

E. Copper sheet and scrapings

In February 1962, Sri S. R. Rao, Superintendent, Archaeological Survey of India, Northern Circle Agra, sent from camp Lothal a large quantity of what was suspected to be copper slag (?) and reported to have been found along with muffies and crucibles.

All these three specimens have been examined and chemically analysed with the following results :—

(i) Copper sheet

This specimen was received in the form of large chunks of varying sizes with an approximate thickness of 3 to 5 cms. These flattish lumps were of a dirty green to bluish green colour and presented a rough earthy surface containing numerous nodular fragments of greenish material sticking out all over. The close examination of some of these fragments has shown that bits of pottery are imbeded in them, and some very clear impressions of vegetable fibres or reed marks are also noticeable. The lumps can be easily broken by applying a little pressure of hand. Although the surface is highly uneven and porous and is studded with numerous noduler pellets of green material, fragments of pottery and pieces of bone, there do not appear to be any vesicular cavities or blow-holes indicating the action of fire and the formation of molten material.

The study of surface features suggested that these lumps might not be specimens of copper slag. This has been confirmed by chemical examination and there is no doubt that

Note ; It is only a corroded metallic lump.

TABLE XXIX

CHEMICAL ANALYSIS OF METALLIC SPECIMENS FROM LOTHAL (HARAPPAN LEVEL)

Sl. No. of specimen	Antiquity No. from which Sps. drawn	Description of specimens	CHEMICAL ANALYSIS: Copper	Iron	Tin	Lead	Nickel	Zinc	Acid -in-soluble residue	Oxygen by difference	Total
1	5	6	4	5	6	7	8	9	10	11	12
1.	625	Copper arrow head	97·70	—	—	—	Traces	—	—	2·3	100
2.	3872	-do-	70·30	Traces	—	—	1·50	—	0·50	27·70	100
3.	4148	Copper fragment	74·84	0·61	—	—	Traces	—	4·43	20·10	100
4.	4189	Copper object	70·69	0·90	—	—	,,	6·04	6·04	22·37	100
5	4759	Copper fragment	79·89	Traces	—	3·60	,,	—	0·20	16·31	100
6.	4813	Copper lump	93·65	,,	—	1·51	1·55	—	0·49	2·80	100
7.	5501	Copper rod	88·60	,,	—	—	Traces	—	0·30	11·10	100
8.	5590	Copper object	87·08	,,	—	—	,,	—	—	2·92	100
9.	SRG-324	Copper fish hook	91·60	—	—	—	,,	—	—	8·40	100
10.	SRG-B (20)	Copper hand axe (celt)	91·87	Traces	—	—	0·80	—	0·20	7·11	100
11.	3091	Copper hand axe (celt)	94·33	—	—	—	Traces	—	0·37	5·30	100
12.	—	Copper revetted jar (Broken vessel)	43·00	1·00	—	—	—	—	2·23	53·77	100

the specimen in question represents the corrosion product of copper objects produced as a result of prolonged mineralisation on account of inhumation in the saline soil of Lothal. The lumps are readily soluble in diluted hydrochloric acid with vigorous effervescence and evolution of carbon-di-oxide. In a few hours as a result of action of hydrochloric acid, large lumps crumble to smaller bits producing a lot of earth matter and a deep green coloured solution of cupric chloride. Traces of iron and phosphate are also detectable.

Copper slag is insoluble in hydrochloric acid and does not produce effervescence with acids nor does it evolve carbon-di-oxide with acids. Since silicates which constitute the major component of a metallic slag, be it iron slag or copper slag, are not attacked by acids and show vesicular cavities and blow holes indicating its solidification from molten state and since, copper slag is much more compact and is considerably harder than the specimen under examination. It is obvious that basic copper carbonates with a green to bluish green colour have been produced as a result of conversion of large sheets or plates of metallic copper producing the flattish chunks under examination. No tin could be detected in the specimen. The specimen is therefore not copper slag, but it is a corrosion product of some copper object which underwent prolonged mineralisation on account of inhumation in the saline soils of Lothal. Detailed photographs of the two surfaces of a chunk of the specimen show that there are distinct impressions of vegetable fibres or reed marks on one side of the specimen; such impression could have been produced by the deposition of corrosion products of copper in contact with the vegetable fibres Such impressions could not have been produced on siliceous matter which solidified from molten condition.

(ii) Scrapings from terracotta crucibles

The terracotta crucibles from which these specimens of scraping were collected were reported to have been used for housing molten copper for metal working. These scrapings were treated with hot con. hydrochloric acid when solution took place and some undissolved clay was left behind. The solution gave a negative test for tin, lead, nickel, arsenic and copper. The chemical analysis was repeated very carefully to establish the presence of copper in the specimen but copper was found to be absent. It seems that the specimens of scrapings represent clay rich in iron. The iron compounds may have come from ferruginous clay.

2. FAIENCE AND STEATITE SPECIMENS FROM LOTHAL

Sixteen specimens of faience objects and fifteen specimens of steatite artifacts were received for chemical analysis and scientific examination in this laboratory. All these specimens have been examined and the results of this investigation are detailed below :

1. *Specimen No. 11901*—Bangle piece (Green faience)

This specimen is greenish white in colour with a hardness between 6 and 7 and a conchoidal fracture and vitreous lustre. Its specific gravity is 2·8 and it has got a higher refractive index than that of Canada balsam.

The specimen has been found to contain a high proportion of silica and an appreciable amount of lime and a little iron oxide. The colour is due to ferrous compounds. The object seems to have been made by moulding mixture of crushed quartz and a little lime and firing it at a high temperature. The body of the specimen shows a granular structure and angular grains of quartz are distinctively visible. The specimen is made of faience with ferrous compounds as colouring agent.

2. *Specimen No. 5927*—Bead (Decoloured faience)

The material of this object is very similar to that described in the case of specimen No. 11901. Silica is present in a large proportion with a small amount of lime and a very small proportion of iron compounds. The material appears to be faience, and the colour is due to iron compounds.

3. *Specimen No. 362*—Beads (Green Faience)

The material of these beads is the same as that described above. The beads have been prepared by moulding crushed quartz powder mixed with a little lime with iron compounds as colouring matter. The specimens are made of faience and the green colour is attributable to iron compounds.

4. *Specimen No. 5904*—Beads (Bluish green faience)

The material of these beads is the same as that used in specimen No. 11901 already described. The colour is due to compounds of rion. The body has a coarse granular texture with numerous angular grains of quartz cemented together in clear colourless material.

5. *Specimen No. 5988*—Bead (Decoloured faience)

The material of this bead has the same composition as found in the case of specimen No. 11901. It has a coarse granular texture and is highly silicious containing a very small proportion of calcium compound and only traces of iron compounds.

6. *Specimen No. 329*—Bead (Coarse faience)

In texture the body of the specimen resembles the body of the beads described above. It has a very high proportion of silica and a much smaller proportion of lime and iron compounds than in other specimens. It is rather coarse and granular in texture and represents faience.

7. *Specimen No. 14047*—Bead (Greenish white faience)

This bead is made of greenish white faience with a granular texture and it is highly silicious, containing only traces of calcium and iron compounds. The firing has been done at a high temperature so that the angular grains of quartz are cemented together with an argillaceous cement.

8. *Specimen No. 14257*—Bead (Glazed and green faience)

The body material of this specimen is a coarse grained silicious composition approximating in chemical composition to ordinary faience. It contains an appreciable amount of iron compounds; probably glauconite may have been powdered and mixed with the silicious paste out of which this bead was moulded. It has got a coarse granular texture and carries traces of original glaze which has however, broken down considerably.

9. *Specimen No. 7920*—(Glazed and green faience)

This bead is highly silicious containing a very small proportion of iron compounds which have imparted a green colour to it. Its composition is similar to that of specimen No. 11091.

10. *Specimen No. 99*—Bead (Green faience)

In texture and composition this bead resembles specimen No. 11901. The body is made of a highly silicious paste containing a small amount of calokum compounds with

with traces of iron compounds which are responsible for the green colour. The body material is a coarse granular faience.

11. *Specimen No. 14190*—Bead (Glazed Blue faience)
This specimen is made of a coarse granular silicious paste. Only iron could be detected as a tinctorial agent in this specimen. It is a coarse granular faience and its colour is attributable to iron compounds. Traces of glaze are still present on the surface of the bead

12. *Specimen No. 11410*—Bead (Blue faience or lapis)
The body has got a hardness of 5-6 and is azure blue in colour with an uneven fracture and vitreous lustre, it has a sp. gr. of 2.4. Microscopic examination has shown that the specimen has a low refractive index and is easily decomposed by hydrocholoric acid with the evolution of sulphuratted hydrogen. All these characteristics indicate that the bead is made of lapis lazuli. Its description as blue faience is therefore incorrect.

13. *Specimen No. 5994*—Bead (Glazed faience)
This bead is made of a coarse granular paste which is highly silicious containing a small proportion of calcium compounds and traces of compounds of iron to which the colour is attributable. It is a glazed faience specimen with iron compounds as the tinctorial agent.

14. *Specimen No. 10185*—Bead (Glazed blue faience)
In chemical composition and texture, this specimen resembles Specimen No. 11901. The body material is highly silicious; the tinctorial agent is oxide of iron. The surface of the bead shows a bluish green glaze.

15. *Specimen No. 352*—Piece (Faience)
The colour of the specimen is greenish white; the hardness is about 1 and the fracture is earty. Its specific gravity is 2·28. The specimen has been found to contain silica, lime and traces of iron. Calcium carbonate has also been found to be present. It is a poorly fired specimen and is not true faience, which does not contain any calcium carbonate and has a hardness of about 6-7. It is therefore an unvitrified paste.

16. *Specimen No. 14630*—Bead (Glazed faience)
This bead resembles specimen No. 11901 in physical proportions and chemical composition.

17. *Specimen No. 12742*—Beads (Steatite ?)
White (circular) Bead.—The bead shows a conchoidal fracture and a vitreous lustre with a hardness of 6-7 and a sp. gr. of 2·59. It has been chemically analysed and found to contain a high proportion of silica and traces of lime. Magnesium was found to be absent. The bead is not made of steatite or steatite paste; it is made of a highly silicious material which has been strongly heated; It is a silicious paste.

Bead (green).—This bead has on examination found to be composed mostly of silica and traces of iron. In chemical composition and texture, it resembles specimen No. 11901. The bead is free from magnesium. It is therefore not made of steatite or steatite paste, but is a fine specimen of grained faience.

Bead (white) Long—(*Steatite ?*).—In texture and chemical composition this bead resembles specimen (17) very closely and has been found to be made of a silicious paste.

18. *Specimen No. 12687*—(Bead)

This bead has a hardness of 5-6 and a sp. gr. of 2.8. It shows an early fracture and a pearly lustre. On chemical analysis it has been found to contain a very high proportion of silica and traces of iron compounds. It is free from magnesium and is therefore not made of steatite or steatite paste. It seems that a silicious paste was used for making this bead. Signs of cutting with a short instrument such as saw are distinctly seen on the two faces of the bead.

Specimens Nos. 12452 (Steatite ?), 12596 (i) (Bead—steatite ?). 12544 (bead—steatite ?), 12700 (bead—steatite ?), 12814 (bead steatite ?), 12532 (bead steatite?), 9345 (bead steatite ?), 10192 (bead—steatite ?), 8318 (bead steatite ?), 446 (an object—steatite) and 893 (object steatite ?) are all made of a silicious paste very similar to the one described above. All these specimens have been found, on chemical analysis, to be completely free from magnesium. Natural steatite or steatite paste has thus not been used in making these beads. Treatment of the beads with hydroflouric acid and subsequent ignition to drive off the acid resulted in the disappearance of more than 99% of the material. It is therefore obvious from this hydrofluoriation test that all these specimens are highly silicious, silica being present to the extent of about 99%. Only traces of iron were detected whereas no magnesium could be found in any specimen.

Specimen No. 12596 (2) has been found to be made of calcite. It shows a hardness of 3 with a sp. gr. of 2.7; it effervescence strongly with hydrocholoric acid indicating the presence of a carbonate.

19. *Specimen No. 12450*—Bead (Steatite)

In texture and chemical composition this bead closely resembles the faience specimens described under specimen No. 11901.

20. *Specimen No. SRG 2 B-10 (S)—object of steatite*

This specimen has a hardness of 1 and a sp. gr. of 2.8. Pearly white in colour and with an earthy fracture, pearly lustre and a greasy feel, it has been found to contain a considerable proportion of magnesia and silica. The material is therefore steatite or soap stone.

The examination and chemical analysis of these thirty one specimens has been found to show that highly silicious faience has been used for the fabrication of ornamental artifacts such as beads and bangles. The use of a silicious paste containing a very high proportion of silica was popular with the people of Lothal. Moreover, some natural materials, such as lapis lazuli, calcite and steatite have also been used for making beads. However, no specimen has been found to be made of steatite faience of the type described for Indus valley sites. The use of powdered steatite for making beads and other ornamental objects was not in vogue. Moreover there is no evidence so far as these results are concerned, to show that Lothal craftsmen were conversant with the technique of glazing or coating beads with steatite powder suitably consolidated with an adhesive—a technique which was in extensive use at Indus Valley sites.

3. SPECIMENS OF GOLD FROM LOTHAL

The examination of specimens of gold from Lothal has shown invariable presence of silver and more or less complete absence of copper. There is no doubt that an alloy of gold and silver not containing copper was used by the goldsmiths of Lothal for making ornaments and jewellery of gold. In this connection it may be pointed out that the gold from the Indus Valley sites namely Mohenjo-daro and Harappa, has always been found

to be alloyed with silver. The reports on Mohenjo-daro and Harappa by Sir John Marshall and Shri M. S. Vats respectively however do not contain any quantitative chemical analysis of gold specimens from these Indus Valley-sites, and it is not clear from these reports what proportion of silver was alloyed with gold to produce the material for making gold ornaments and jewellery. It is very difficult to say whether an artificial alloy of gold and silver was used for making ornaments or the natural alloy, electrum, which contains a very high proportion of silver ranging from 25% to 40% was used for making gold jewellery.

In the absence of quantitative chemical analysis and percentage composition of gold objects from Mohenjo-daro and Harappa, it was considered important to subject gold from Lothal to chemical analysis and necessary tests for determining their composition. As a result of this work, it has been found that the two gold pendants Nos. 15180 contain only gold and silver; copper, nickel, lead and zinc have been found to be absent. The yellow pendant which has a Sp. Gr. of 15·02 has given the following composition which is based on physical measurements :—

Gold	..	66·55%
Silver	..	33·45%
Total	..	100·00

The other pendant which is light yellow has given the following composition :

Gold	..	58·52%
Silver	..	41·48%
Total	..	100·00

From the above data it becomes quite clear that an alloy of gold and silver containing about 30% to 40% of the latter metal was used for making the pendants. The question naturally arises whether the material of these pendants represents the native alloy, electrum, or it was made by the alloying required quantities of gold and silver. Since the proportion of silver in the pendants compares favourably with that in the native alloy electrum, it would be natural to attribute the source of the material of the pendants to this natural alloy. This view is further supported by the fact that the pendants are completely free from lead as well as copper. If silver had been alloyed with gold a small proportion of lead should have been found in the pendants. It, therefore, seems probable that the alloy was not prepared artificially by mixing metallic gold with metallic silver but most probably native alloy, electrum was used for making the pendants.

Another question which has to be answered in this connection is whether or not alluvial gold was used for making gold ornaments at Lothal. The examination of the gold and gold-plated objects from Lothal shows that pure gold was not used but invariably gold has been found associated with silver in these objects. It would, therefore, not be unreasonable to assume that alluvial gold was not used by the goldsmiths of Lothal, but natural alloy of gold and silver was used for making gold jewellery.

4. PLASTER WITH PLANT IMPRESSIONS FROM LOTHAL

The specimen has been found to be composed of mud and some minute pieces of wood were also found in it. The specimen was subjected to chemical analysis with the following results.

Loss on ignition	..	12·30%
Silica (SiO_2)	..	53·52%
Ferric Oxide (Fe_2O_3	..	7·20%
Aluminium oxide (Al_2O_3)	..	10·80%
Lime (Cao)	..	10·23%
Magnesis (Mgo)	..	2·82%
Carbon-di-oxide	..	3·20%
Total	..	100·07%

The chemical analysis shows that the specimen represents a calcareous clay containing considerable amount of silt and sand. Evidently it is ordinary loam or mud and does not show any other peculiar features.

CHAPTER XXV

Plant remains from Lothal

By
K. Ramesh Rao & Krishna Lal

1. INTRODUCTION

The material received for examination from the excavation at Lothal comprised over forty samples belonging to three distinct occupational periods, the oldest of which dates back to the latter half of third millennium B.C. Some of the samples on examination were found to contain no traces of any plant remains and are therefore not dealt with in this report. The plant materials consisted mostly of small pieces of charcoal besides fragments of a highly calcined wooden beam, a few samples of impressions on clay lumps, and some seeds and grains. The findings reported here are the results of careful macroscopic study of all the specimens, supplemented by a detailed microscopic examination of selected representative material. Though the preservation is generally poor, it has been possible to determine the botanical identity of most of the charcoal specimens. Six different types have been identified including teak *(Tectona grandis)* and haldu *(Adina cordifolia)*, the occurrence of which at this Harappan site is of considerable interest. The evidence of occurrence of rice in some of the clay impressions is also of no less significance.

2. MATERIAL

In all fortythree samples (two without any number) were received for examination. Out of these, eleven numbered 3 c, 8 a & b, 12 a, b, c, d & e, 20, 21 and 22 were found to be of no botanical significance, as preliminary examination showed that they did not contain any plant material. The remaining thirtytwo samples could be grouped under four different categories as given below.

Table XXX

Plant remains	Sample number
1. Charcoal (24 samples)	1, 2, 3 a & b, 4 to 7, 9 to 11, 13 a & b, 14 a & b, 15 a & b, 16 to 18, 19 a & b, 26 and one sample without number
2. Calcined wood (1 sample)	25
3. Impressions on clay lumps (6 samples)	24 a, b, c d & e and one sample without any number from granary
4. Seeds and grain (1 sample)	23

The above samples fall under three distinct occupational periods as shown in table II.

Table XXVIII

Sample number	Period	Approximate date
1, 10, 14 a & b, 15 a & b, 16, 17, 26 and one sample of impressions on clay lumps without any number	Phase II	2350—2200 B.C.
2, 3 a & b, 5, 7, 9 13 a & b, 18, 19 a and b.	Phase III	2200—2000 B.C.
4, 6, 11, 23, 24 a, b, c, d & e, 25 and one sample of charcoal without any number from kiln.	Phase IV	2000—1900 B.C.

The number and size of charcoal pieces varied considerably in different samples, ranging from only two or three pieces in some, to over several hundred in others. In size the pieces varied from very small not exceeding 1—2 mm in the direction of the longest dimension to fairly large measuring 10 mm × 12 mm × 25 mm. The preservation of the charcoal on the whole was rather poor making processing and identification laborious and difficult. In some of the samples namely 14 a & b, 15 a & b and 16 the charcoal was mostly in the form of fine dust mixed with clay and small extremely friable lumps without any cellular structure. The sample from the wooden beam was found to be highly calcined and almost powdery, crumbling to dust at the slightest touch. The lumps of burnt clay showed good impressions of grain and straw, with fine fragments of the husk and leaf epidermis occasionally sticking to them. The sample of seeds and grain was found to be badly attacked by insects.

3. METHOD OF STUDY

The charcoal specimens were first examined in gross with a view to classifying them into main types based on structure. A hand lens magnifying ten times was found satisfactory for the purpose, though in a few cases examination of freshly broken surfaces incident light under a Zeiss Epignost microscope was found to be necessary. Based on such gross examination, a number of pieces representing the different types of structure found in all the samples were selected for detailed anatomical study. Depending on the state of preservation, the selected material was either embedded in paraffin only or double embedded in clove oil celloidine and paraffin, according to the usual methods followed in the laboratory.[1] Due to the highly calcined and powdery condition of the sample from wooden beam it was almost impossible to get any material showing its anatomical structure. However, by careful manipulation, minute fragments containing what appeared to be wood elements like vessels, fibres etc., were isolated. These were carefully washed in water and then treated with dilute hydrochloric acid for several hours. Though this resulted in the removal of the calcium carbonate, all structural details were completely lost the material becoming a brownish pulpy mass. Therefore, in order to preserve whatever structure present the fragments were subjected to dilute hydrochloric acid treatment for short period only keeping the material under microscopic observation throughout. When maximum clarity was

[1] S. S. Ghosh and K. A. Chowdhury in Ancient India, No. 13 (1957), p. 133; K. A. Chowdhury and S. S. Ghosh, 'The study of archaeological plant-remains and its significance', *Trans. Bose Res. Inst.*, Calcutta (1955), p. 81.

obtained the fragments were removed from acid, washed, dehydrated and mounted as usual. Some preparations were also made from similar fragments treated only with hydrogen peroxide. Fragments of husk and leaf epidermis adhering to the impressions on the clay lumps were cleaned in dilute hydrochloric acid and mounted after dehydration. The photomicrographs were taken with a Reichert universal camera microscope in transmitted light.

4. RESULTS OF STUDY AND IDENTIFICATION

A. Charcoal

As already stated earlier, out of the twentyfour charcoal samples received, five consisted mostly of fine powder mixed with soil and some black irregular lumps with hardly any structure. Though these could possibly have been some kind of wood charcoal it was impossible to identify them due to the lack of any structural details. Examination of the remaining nineteen samples, however, revealed the presence of at least six distinct types in the different occupational strata. Of these, it has been possible to determine the botanical identity of three up to the species, two to the generic level, while one could be identified only up to the family as given in table XXXI.

Table XXXI

Determination of charcoal remains

Sample No.	Period	Contents	Identification
1	II	3 pieces	*Albizzia* sp.
2	III	About 20 very	*Acacia* sp.
3a	III	3 fairly large and small pieces several very small pieces	*Acacia* sp.
3b	III	4 pieces	*Acacia* sp.
4	IV	6 pieces	*Acacia* sp.
5	III	2 fairly large and about 20 small pieces	*Albizzia* sp.
6	IV	2 pieces	*Acacia* sp.
7	III	3 pieces	*Acacia* sp.
9	III	About 10 pieces	*Acacia* sp.
10	II	5 pieces of 2 types	(a) *Acacia* sp. (b) *Adina cordifolia*
11	IV	2 pieces	*Acacia* sp.
13a	III	4 pieces	*Soymida febrifuga*
13b	III	About 14 fairly large pieces and several small fragments	*Soymida febrifuga*
17	II	4 pieces	*Tectona grandis*
18	III	3 pieces	*Acacia* sp.
19a	III	3 pieces	*Adina cordifolia*
19b	III	2 pieces	*Adina cordifolia*
26	II	3 small pieces	*Lauraceae*
Sample from kiln	IV	Hundreds of pieces of varying size.	*Acacia* sp.

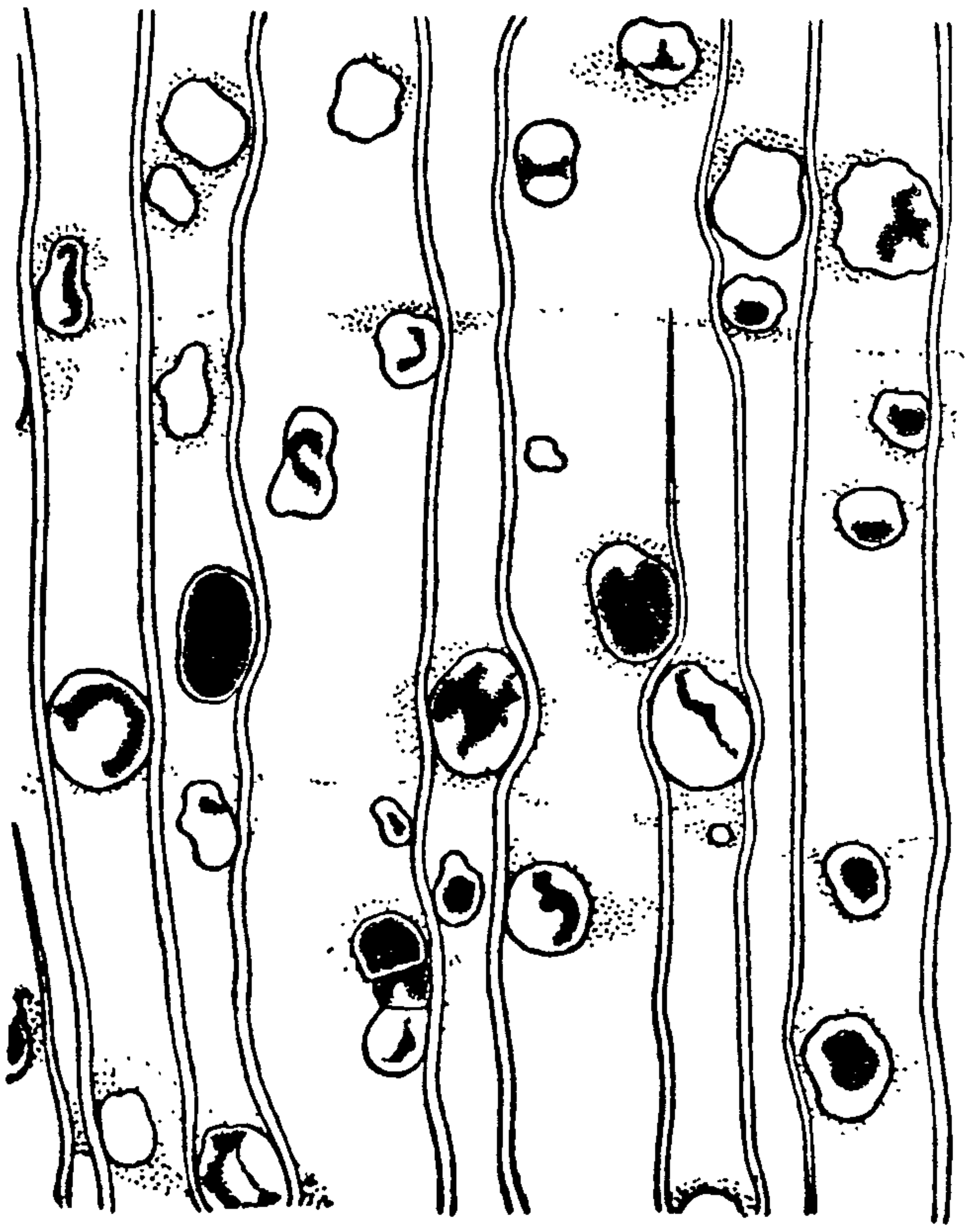

FIG. 141. *Transverse section(x55) showing vessel arrangement and parenchyma distribution*

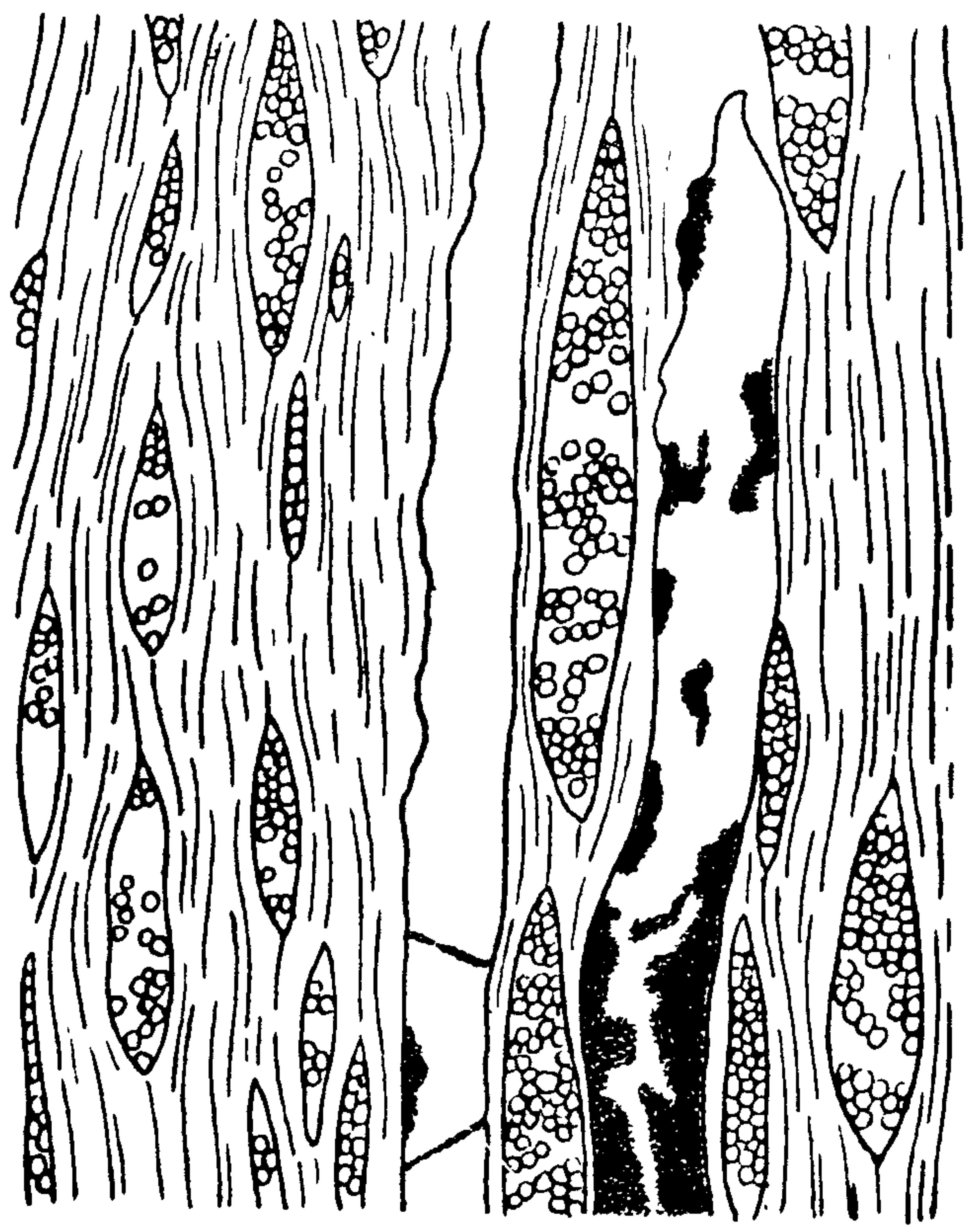

FIG. 142. *Tangential section(x135) showing partly deteriorated 1-6 seriate homocellular ray*

From the samplewise determinations given in the table it will be seen that while some species like *Tectona grandis* may be found only in a single sample, others are represented by two or more samples. Thus *Albizzia* sp. and *Soymida febrifuga* are found in two samples, *Adina cordifolia* in three and *Acacia* sp. in as many as eleven out of the eighteen samples studied. Therefore, as samplewise description would lead to needless repetition, it is proposed to consider here the different types of charcoal only according to their botanical affinities.

Type 1. Acacia sp.
(Fig. 141 and 142; Pl. CCCI, 1 and 2)

Material—Sample Nos. 2, 3a, 3 b, 4, 6, 7, 9, 10, 11, 18 and sample from kiln, without any number.

General features—The large number of charcoal specimens falling under this category vary considerably in size from very small fragments to fairly large pieces, the biggest measuring about 10×12×25 mm. They are usually irregular in shape often with numerous fine cracks both along and across the grain. On account of these fissures and not too good preservation, even the larger pieces are liable to break into smaller bits while handling. The grain as could be seen from the bigger specimens is fairly straight to somewhat twisted and the texture even and medium-coarse. *Anatomical structure*—It is a *diffuse porous wood. Growth rings* usually not observed, but are faintly visible in a few specimens delimited by a fine broken line of parenchyma. *Vessels* are small to medium-sized or moderately large, the latter just visible to the eye and the former visible only under the lens, few to moderately numerous, mostly solitary with a few short radial multiples; round to oval in outline, the largest measuring 140 to 210/u in diameter, often partially or completely plugged with black gummy deposits. *Parenchyma* is predominantly vasicentric occurring as a narrow to fairly wide roundish sheath round the vessels, occasionally confluent connecting adjacent vessels, distinctly visible under the lens. *Rays* are fine to moderately broad, somewhat wide apart to fairly closely spaced (5 to 8 per mm), 1 to 6 seriate, the largest up to 98 u in width and upto 30 cells and 720 u in height; homocellular.

Type 2. Albizzia sp.
(Fig. 143 and 144; Pl. CCCI, 3 and 4)

Material—Sample Nos. 1 and 5.

General features—The charcoal pieces of the two samples belonging to this type number approximately twentyfive, of which about twenty are small and fragmentary. The remaining five are fairly large measuring from 3 × 4 × 4 mm to 10 × 12 × 15 mm. All of them have fine longitudinal cracks and horizontal fissures and tend to break easily. The grain is fairly straight and the texture medium-fine to somewhat coarse.

Anatomical structure—It is a *diffuse porous wood. Growth rings* are indistinct in the specimens available for study. *Vessels* are small to medium-sized or large, the latter just visible to the eye and distinct under the lens; few to moderately few, the majority solitary with a few short radial multiples; round in outline but sometimes somewhat flattened and distorted due to compression; the tangential diameter of the larger vessels varies from 196 to 280 u; some of the vessels are partially plugged with black and gummy deposits. *Perenchyma* is paratracheal, predominantly aliform occurring as distinct eyelets round the vessels and occasionally connecting adjacent ones. *Rays* fine to moderately broad, somewhat wide apart to fairly closely spaced (5 to 7 per mm.), 1 to 6 seriate (mostly 3 to 4 seriate), the largest up to 98 u in width and up to 32 cells and 756 u in height: homocellular.

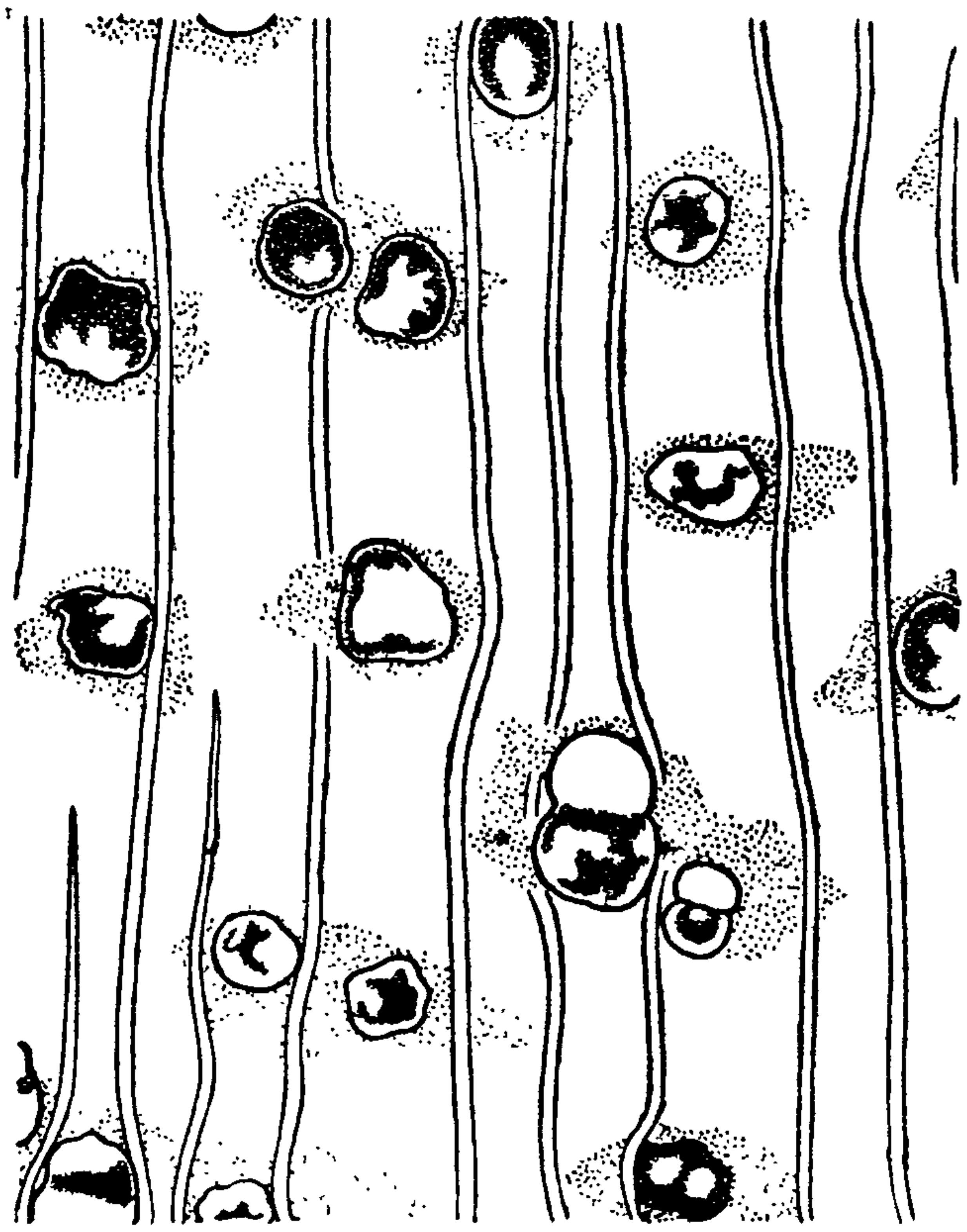

FIG. 143. *Transverse section(x55) showing moderately few vessels with aliform parenchyma*

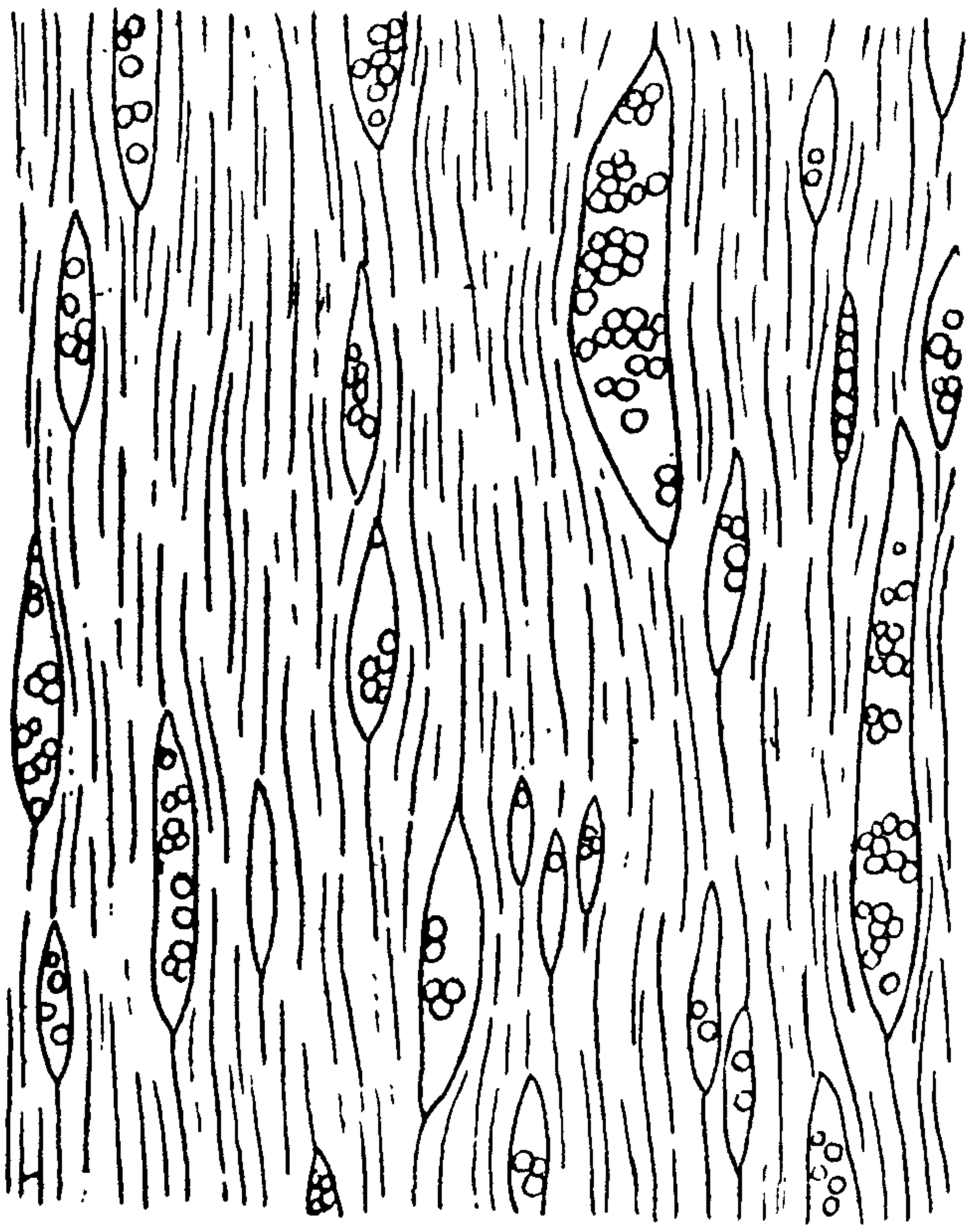

FIG. 144. *Tangential section(x135) showing partly deteriorated, mostly 3-4 seriate rays*

Type 3. Tectona grandis Linn. f.
(Fig. 145 and 146; pl. CCCII, 1 and 2)

Material—Sample No. 17.

General features—The material consists of four somewhat irregular pieces varying in size from 8 × 4 × 4 mm to 8 × 5 × 7 mm. The preservation is very poor, the specimens tending to crumble into small bits while handling. The grain is fairly straight to somewhat twisted and the texture medium-coarse and uneven.

Anatomical structure—It is a *ring-porous* wood. However, the ring-porous character is distinctly seen in only two of the four pieces, as the others do not show complete growth rings.

Growth rings are distinct, delimited by a fairly continuous zone of large earlywood vessels. *Vessels* are large, 168 to 280 u in diameter and indistinct to the eye in the earlywood, gradually becoming smaller and visible only under the hand lens in the latewood. *Parenchyma* initial and paratracheal surrounding and partially embedding the large earlywood vessels, but due to the highly deteriorated condition the individual cells are not distinct. *Rays* are find to fairly broad, somewhat widely spaced (5 to 6 per mm), 1 to 6 seriate, the largest up to 98 u in width and up to 30 cells and 700 u in height; homocellular to somewhat heterocellular.

Type 4. Adina cordifolia (Foxb.) Hk. f.
(Figs. 147 and 148; pl. CCCII, 3 and 4)

Material—Sample Nos. 1 0, 19a and 19 b.

General features—Only 7 or 8 pieces belong to this type. They vary considerably in size from small fragments measuring about 2 × 2 × 2 mm to fairly big pieces up to 10 × 8 × 7 mm. Due to the presence of fine longitudinal cracks and poor preservation the material is extremely fragile and liable to crumble. On account of the small size of the specimens it is difficult to make out the grain; however, it appears to be fairly straight and the texture uniform and fine.

Anatomical structure—It is a *diffuse porous* wood. *Growth rings* are indistinct to the naked eye but are delimited under the microscope by denser fibrous tissue and somewhat smaller and fewer vessels in the latewood. *Vessels* are very small to small visible only under the len very numerous and more or less evenly distributed, mostly solitary with a few radial multiples of two or rarely three, round to somewhat angular in outline, the largest 84 to 112 u in diameter. *Parenchyma* diffuse to diffuse-in-aggregates occurring as single scattered cells or short tangential groups of 2 or 3 cells distributed evenly throughout the fibrous ground mass. *Rays* are fine to very fine closely spaced (8 to 10 per mm), 1 to 3 seriate (mostly 1 to 2), the largest up to 56 u in width and 630 u in height; distinctly heterocellular.

Type 5. Soymida febrifuga A. Juss.
(Figs. 149 and 150, pl. CCCIII, 1 and 2)

Material—Sample Nos. 13 a and 13 b.

General features—The material consists of about fourteen fairly big pieces ranging in size from 6 × 4 × 4 mm to 8 × 8 × 8 mm and several small fragments. The bigger charcoal pieces are irregular in shape and show somewhat twisted grain and rather coarse texture.

Anatomical structure—It is a *diffuse-porous* wood. *Growth rings* distinct under the hand lens, delimited by a fine line of parenchyma. *Vessels* are small to medium-sized the largest measuring 182 u in diameter, few to moderately few, mostly solitary and in radial multiples

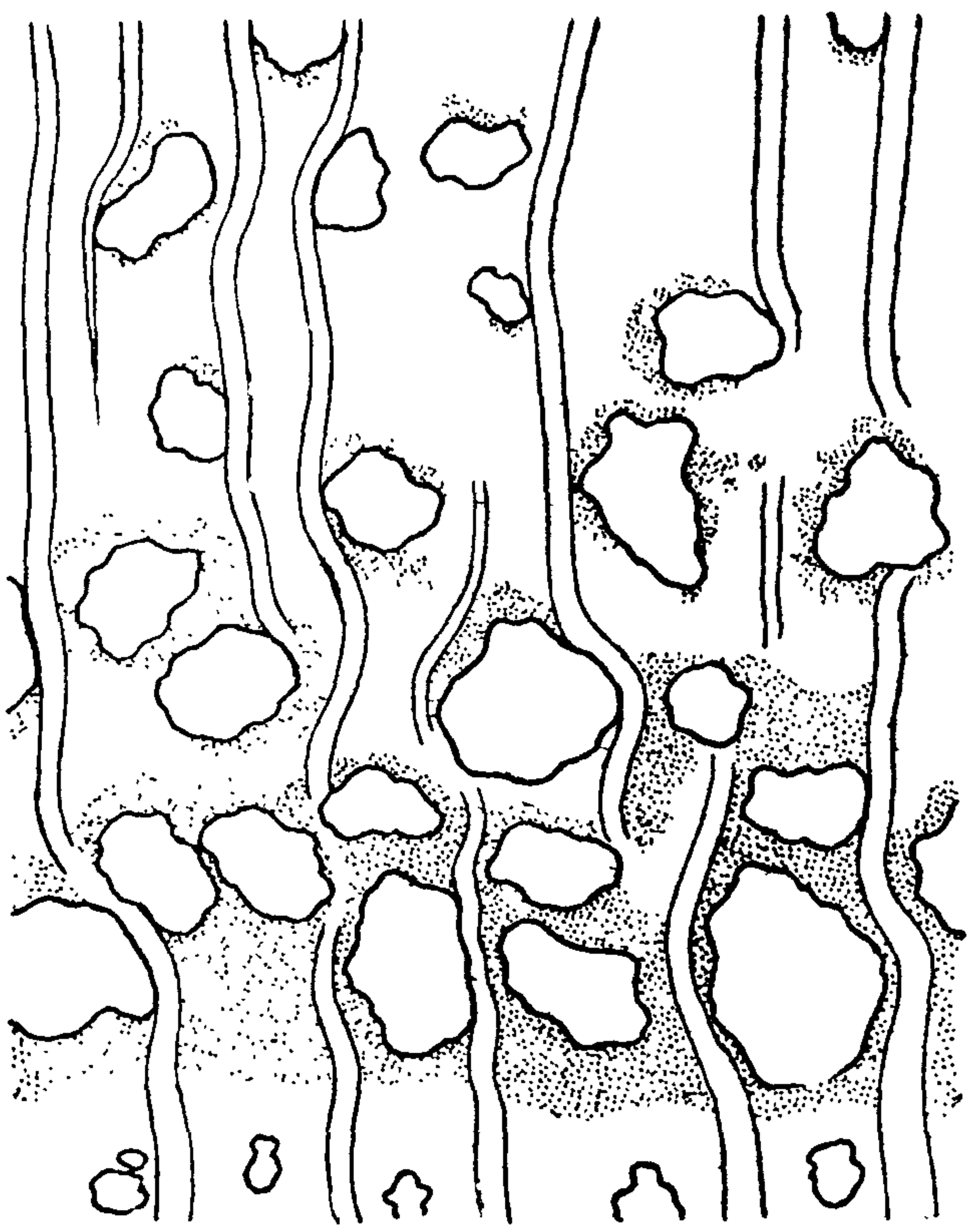

FIG. 145. *Transverse section(x55) showing ring-porous character and parenchyma in association with early wood vessels*

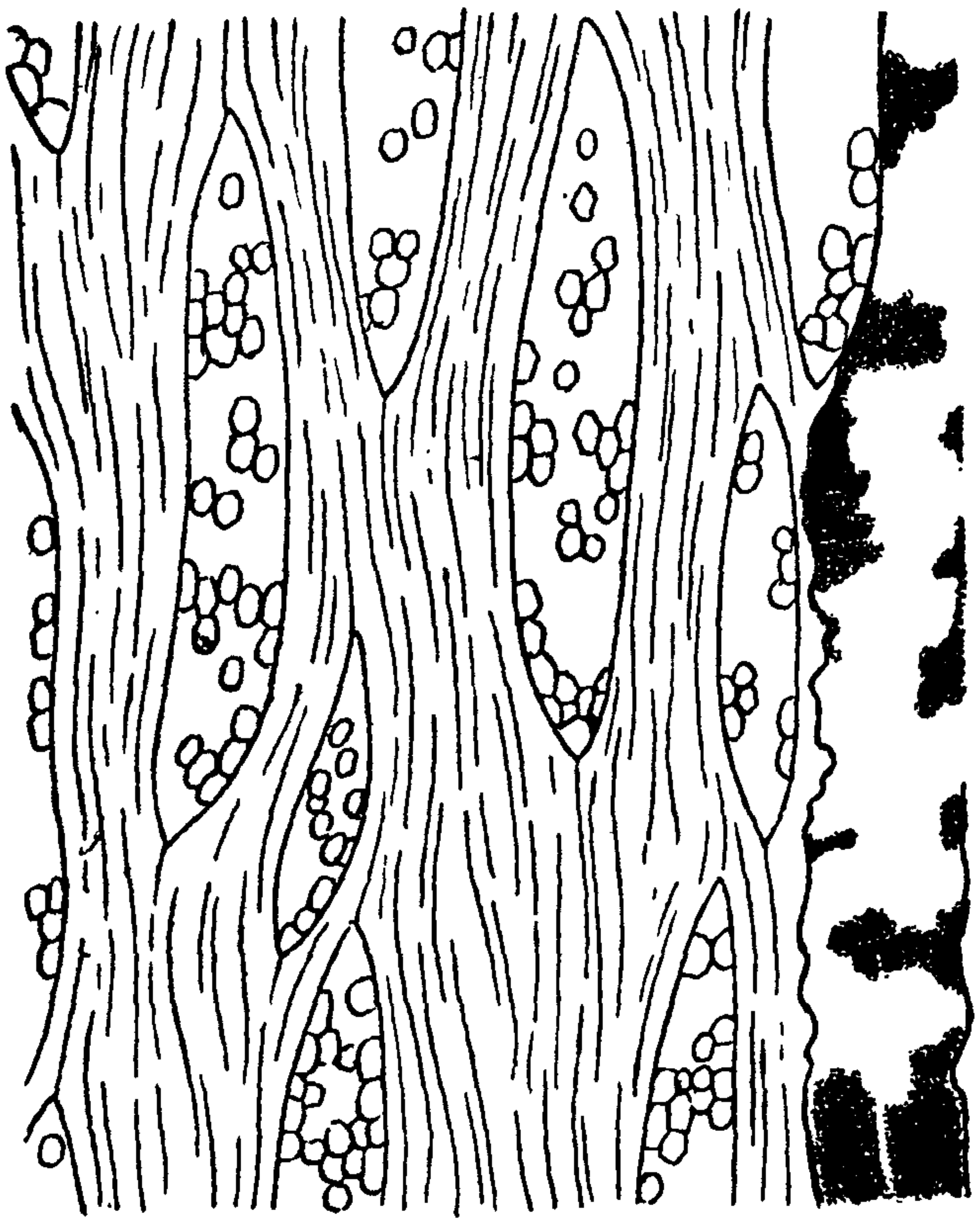

FIG. 146. *Tangential section(x135) showing arrangement and structure of the partly deteriorated rays*

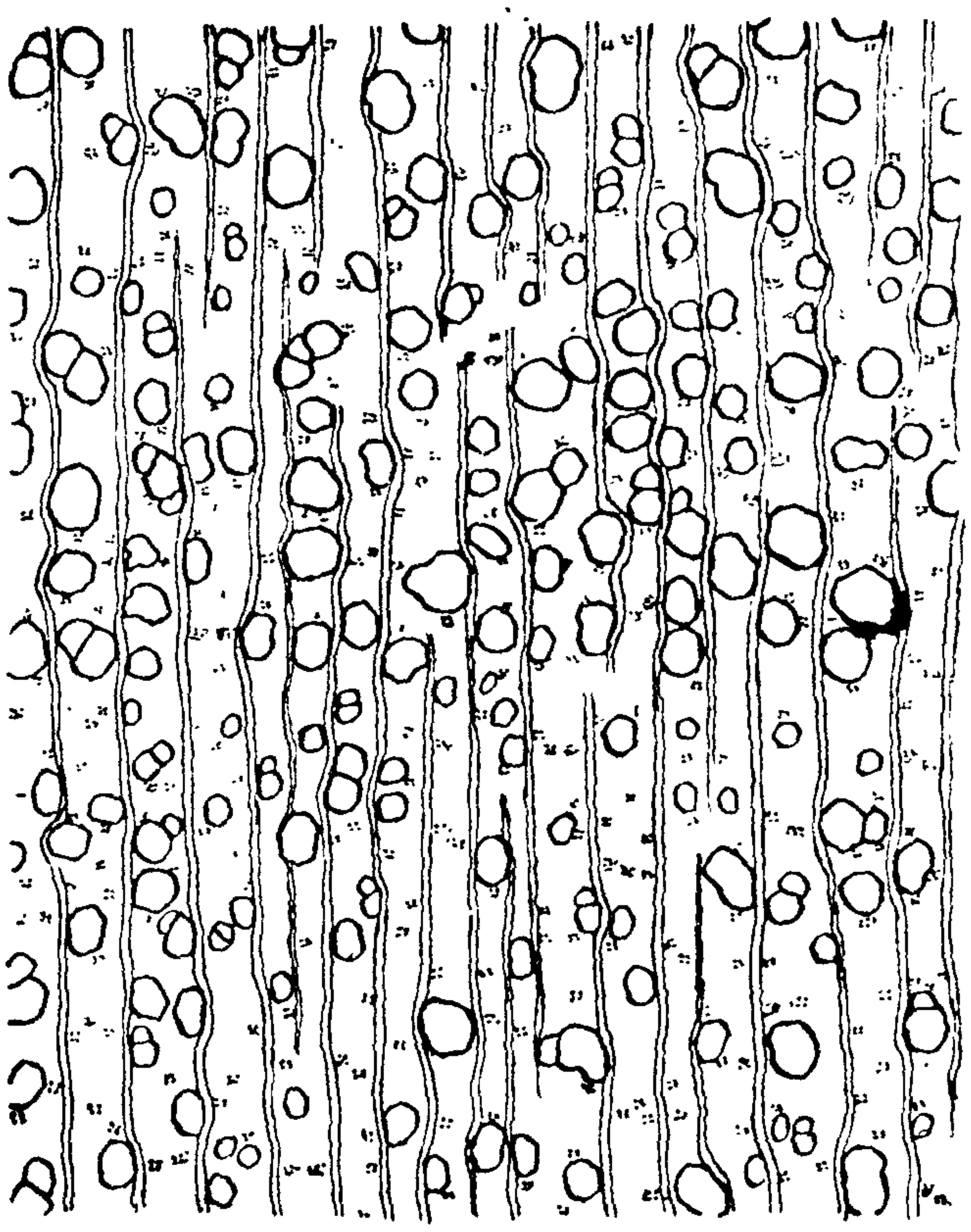

FIG. 147. *Transverse section(x55) showing very numerous, small vessels and scattered parenchyma*

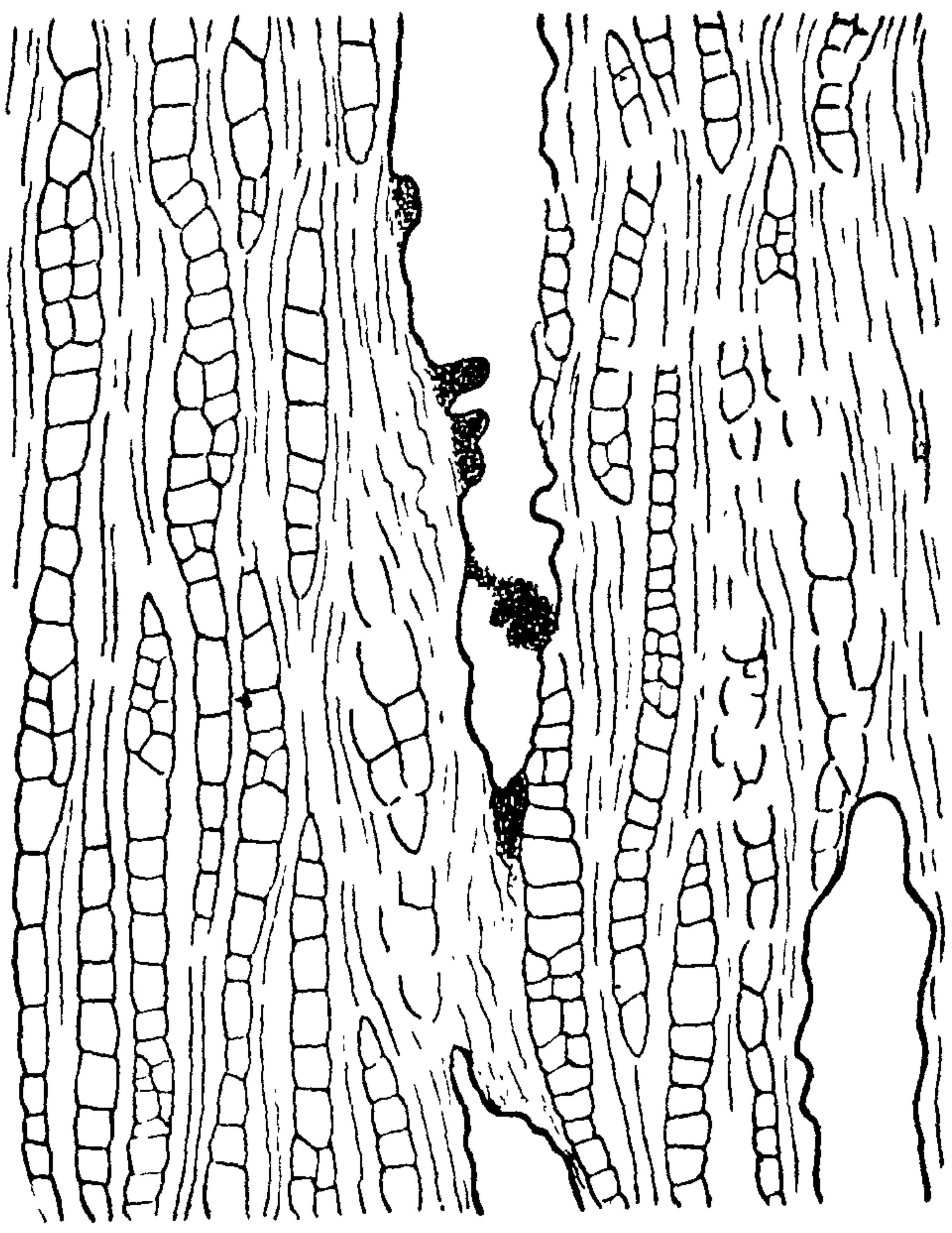

FIG. 148. *Tangential section (x135) skowing 1-2 seriate, distinctly heterocellular rays*

of 2 to 3, round to oval in outline, mostly plugged with hardened black gummy deposits. *Parenchyma* delimiting the growth rings as a narrow somewhat irregular and continuous band 1 to 3 or more cells wide, also forming inconspicuous and often interrupted sheaths round the vessels and occurring as scattered single cells or short tangential groups. *Rays* are fine to moderately broad, rather wide apart to fairly closely spaced (4 to 8 per mm); 1 to 8 seriate (mostly 4 to 5 seriate), the largest up to 40 cells and about 1200 u in height; somewhat heterocellular.

Type 6. Charcoal from dockyard

(pl. CCCIII, 3 and 4)

Material—Sample No. 26.

The sample was collected from charred wood remains found at a depth of 6 to 7 feet in a channel adjoining; the dockyard, and consists of about 8 to 10 small charcoal fragments, the largest not exceeding 4 × 2 × 6 mm in size. The texture is uniform and medium-fine and the structure quite distinct from that of the five types described earlier. As the specimens appear to be from near the pith, where the structure is usually somewhat different from the mature wood and not typical, and also in view of the limited field, definite identification is not possible. However, the diffuse-porous structure of the wood, the general arrangement of the vessels and the characteristic pattern of distribution of relatively large thin-walled parenchyma cells surrounding them as seen in a cross section are suggestive of a Lauraceous wood. Further, though the rays are not well preserved, the occasional presence of what appear to be oil cells also confirms that the specimen probably belongs to the family *Lauraceae.*

B. Calcined Wooden Beam

(Pl. CCCIV, 6, 7, 9 and 10)

The material (Sample No. 25) consists of a portion of a 10 ft. long wooden beam found in trench C ; 2 of plot SRG 3 at a depth of 2 feet 6 inches below the floor level. In spite of the chemical treatment given to hold the beam together, the condition of the beam sample measuring about 18 inches in length at the time of receipt was found to be almost useless for critical anatomical study. It is highly calcified consisting mostly of limestone and clay with hardly any wood structure. However, as already stated earlier, minute fragments which appeared somewhat promising were isoloted and slides prepared for microscopic study. These preparations clearly show wood elements like vessels, fibres and ray parenchyma. The vessel elements are rather short varying from 140 to 308 u in length and 168 to 190 u in diameter, with simple perforations. Inter-vessel pits are numerous but not crowded, oval to orbicular in outline with broad border and lenticular orifice, about 7 to 10 u in diameter. Though the structure is not very clear the pits appear to be vestured. All the above microscopic characters are found in the family Leguminosae to which *Acacia* and *Albizzia* described earlier belong. Therefore, though no definite identification can be attempted on the basis of the meagre data available, there is no doubt that it is a hardwood and it may possibly belong to the Leguminosae.

C. Impressions on Clay Lumps

(Pl. CCCIV, 1 to 5 and 8)

The burnt clay lumps with impressions were received for examination in two separate lots. The first consists of five samples labelled 24a, b, c, d and e, from Phase IV. These are

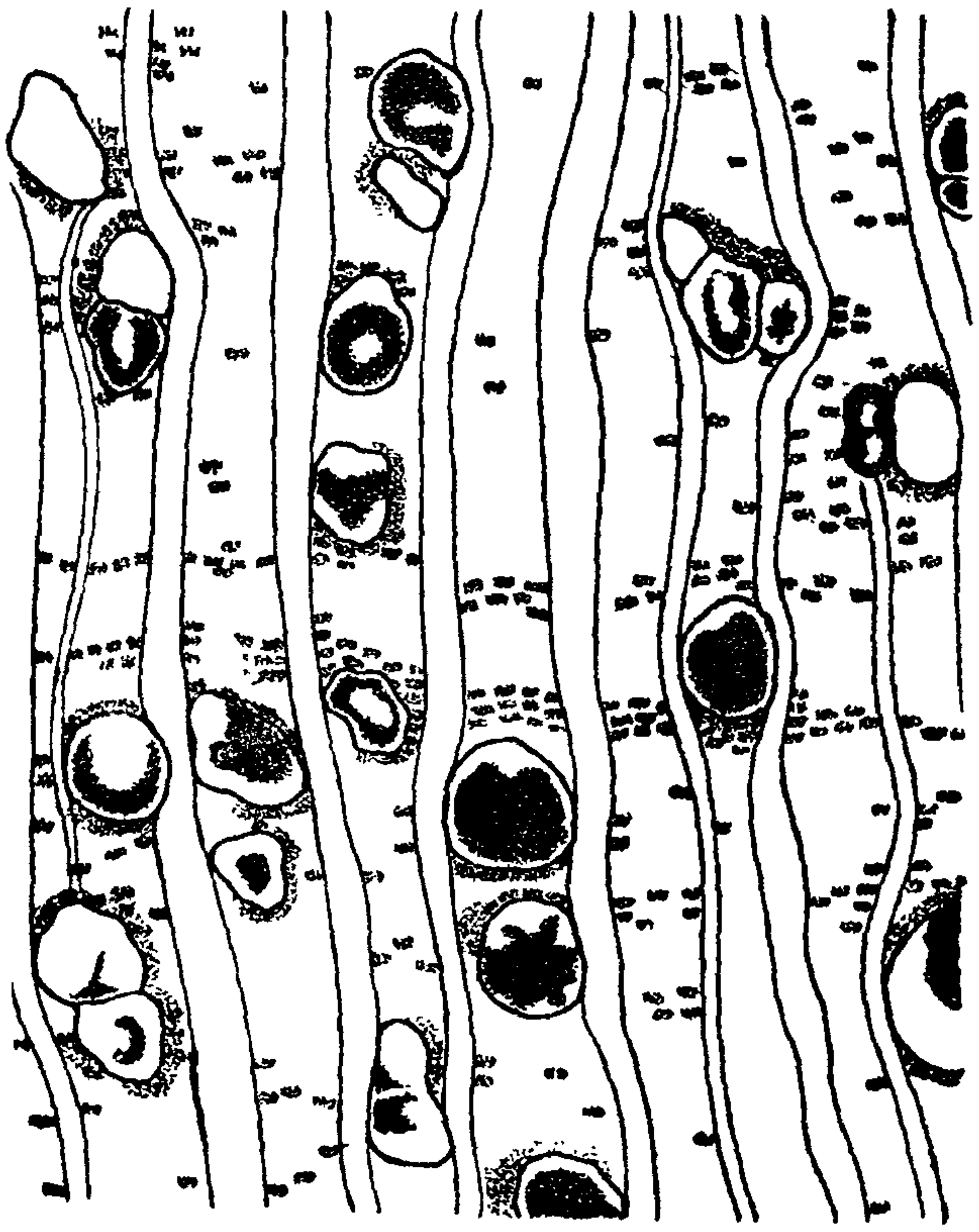

FIG. 149. *Transverse section(x55) showing vessels plugged with deposits and arrangement of parenchyma*

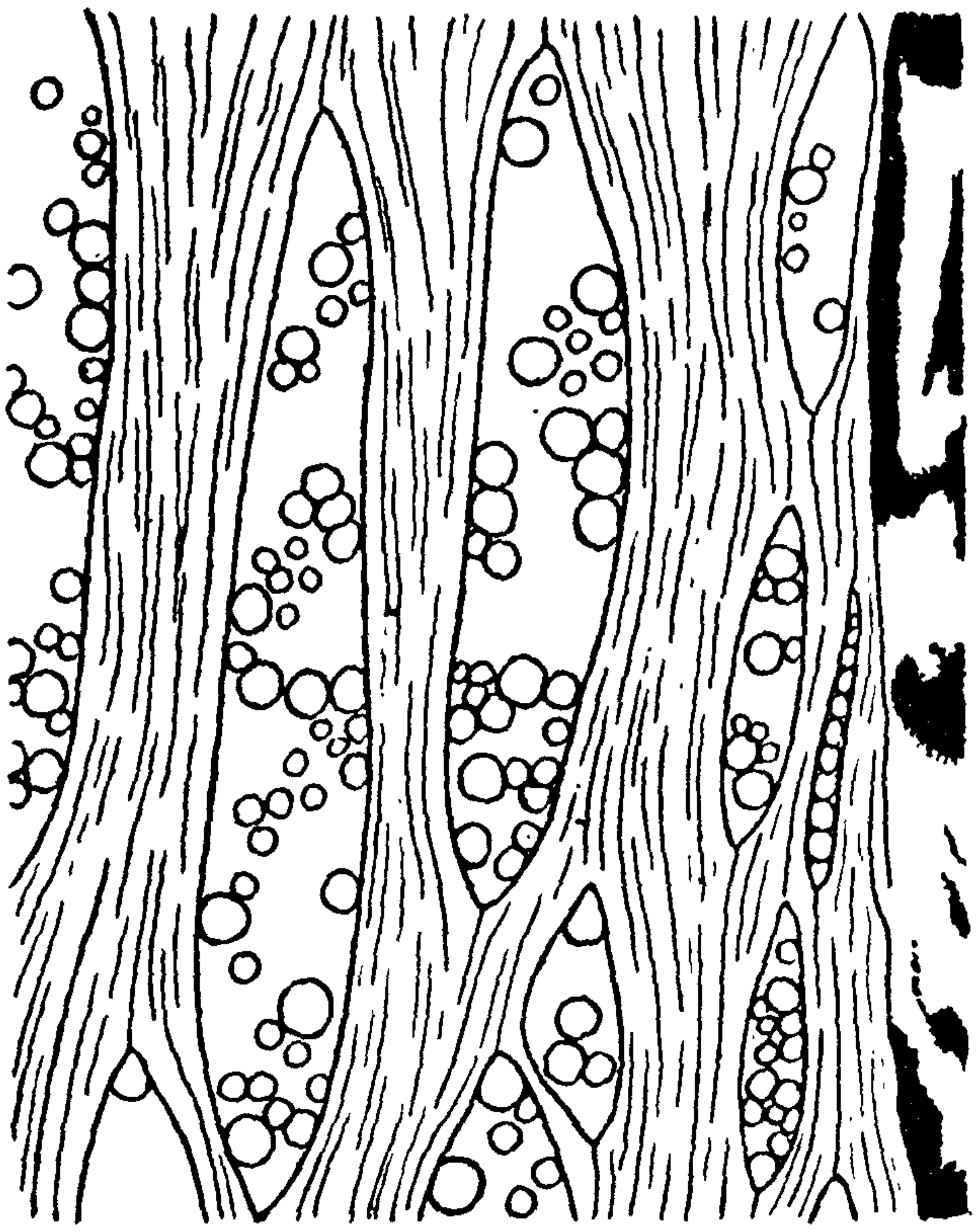

FIG. 150. *Tangential section (x135) showing large partly deteriorated rays*

somewhat roundish to irregular in shape measuring about 4 to 6 cm in diameter, and show on the surface clear stem and leaf like markings. The leaf impressions are 4 to 5 mm width with distinct parallel venation and well defined mid-rib and are undoubtedly of a monocot, probably one of the Graminae. More precise determination is not possible as the impressions do not have any epidermal fragments adhering to them.

The second lot which does not bear any sample number comprises eleven rounded to irregular lumps similar to those described above in shape and size. These come from the channels of a mud-brick structure of twelve cubical blocks built on a 13 ft high platform of mud-bricks, which according to Sir Mortimer Wheeler is a granary comparable to those found at Harappa and Mohenjo-daro[1] and can be assigned to Phase II of Lothal dating back to approximately 2300 B.C. The impressions are very clear and include both grain and straw. The former measure 5 to 7 mm in length and 2·5 to 3·0 mm in width. Fertile lemma and palea are also distinctly recognizable in some of the impressions. However, more important than the impressions themselves are the actual fragments of husk and straw occasionally found sticking to them. Microscopic examination of the husk preparations shows the characteristic features of rice (*oryza* sp.) especially the zig-zag pattern of epidermal cells with dagger shaped hairs and silica crystals.[2]

Anatomical examination of the microscopic preparations made from minute epidermal fragments attached to the leaf impressions also confirms that they are of rice. Though the preservation of the leaf epidermis is not very good, it clearly shows well defined costal and intercostal regions. The former consist of numerous pairs of short cells arranged in a row with characteristic 'Oryzoid' type silica bodies and large prickles. The intercostal region shows a medium zone consisting of long cells with prominent 'V' pointed sinuous walls flanked on either side by a zone in which the cellular structure of the constituent long cells and stomata is not at all preserved. From the structural details of the husk and the leaf epidermis we may come to the definite conclusion that the impressions found in these clay lumps are of *Oryza* sp.

D. Seeds and Grain

Only a very small quantity of seeds and grain was received under Sample No. 23 collected from a pot at a depth of 2 ft. 8 inches in trench B 1 of plot SRG 3. The material is badly damaged by insects and due to lack of structural details cannot be identified with any degree of certainty. However, it appears to consist of two types namely a dicotyledon and a cereal. The seeds of the former are flat, ovate and rather pointed at one end. They are approximately 1 mm in thickness and measure about 3·5 to 4 mm in length and 2 mm in width. The appearance suggests similarity with *Sesamum indicum* D.C *(til)*. The few grains of the cereal available for examination are roundish resembling some of the millets particularly *Setaria italica* Beauv *(kāngni)*.

5. DISCUSSION

The plant remains excavated at Lothal, are fairly rich in variety and number, comprising several kinds of dicotyledonous wood and charcoal, husk and leaf epidermis of rice, leaf and stem impressions of a monocot and some seeds of dicot and monocot. Apart

[1]This is a warehouse where 65 T. C. sealings were found. Rice husks and chaff were used in thick mud plaster covering the cubical blocks. The warehouse caught fire in an accident.

[2]S. S. Ghosh, 'Further records of rice (*Oryza* spp.) from ancient India, *Indian For.* 87 (1961), p. 298.

from botanical interest, their identification is of considerable importance as it gives us some idea of the vegetation, climate and culture that prevailed in the region about 4000 years ago. For a better understanding of any climatic and floristic changes that might have taken place, it is convenient to group the plant remains according to their occurrence in various occupational periods as given in table XXXI below.

Table XXXI

Occurrence of plant remains in different periods

Period	Identification	Sample number	Remarks
Phase II (2350-2200 B.C.)	1. *Acacia* sp.	10 (in part)	Charcoal.
	2. *Albizzia* sp.	1	Charcoal.
	3. *Adina cordifolia*	10 (in part)	Charcoal.
	4. *Tectona grandis*	17	Charcoal.
	5. Lauraceous wood	26	Charcoal.
	6. *Oryza* sp.	Sample without number	Impressions on clay lumps with fragments of husk & leaf epidermis.
Phase III (2200-2000 B.C.)	1. *Acacia* sp.	2, 3a, 3b, 7 9 & 18.	Charcoal.
	2. *Albizzia* sp.	5	Charcoal.
	3. *Adina cordifolia*	19a & 19b	Charcoal.
	4. *Soymida febrifuga*	13a & 13b	Charcoal.
Phase IV (2000-1900 B.C.)	1. *Acacia* sp.	4, 6, 11 and one sample without number	Charcoal.
	2. Harewood (Leguminosae ?)	25	Calcined wood.
	3. *Sesamum indimum* (?)	23 (in part)	Seeds.
	4. Millet (?)	23 (in part)	Grain.
	5. Monocot (Gramineae ?)	24a, b, c, d & e	Stem & leaf impressions on clay lumps.

From a study of the identifications summarized above, it appears probable that the vegetation of the region was appreciably richer and more varied in the earlier occupational periods. The charcoal determinations reveal the existance of as many as five different hardwood species in the earliest period or Phase II which dates back to 2350 B.C. The occurrence among these of *Tectona grandis* (teak), *Adina cordifolia* (haldu) and an unidentified wood belonging to the family Lauraceae is of particular significance as they have not been recorded so far from any other Harappan site. The other two species identified from this occupational period are *Acacia* sp. and *Albizzia* sp. All are forest trees of importance

furnishing valuable timber.[1] Besides these five species, it may not perhaps be out of place to mention here that all the five samples of charcoal which could not be identified on account of their extremely degraded condition, belong to this occupational period. If their preservation had been fairly satisfactory it is quite possible that they might have yielded one or more species.

Compared with Phase II, the charcoal and wood remains from Phase III and IV show the presence of relatively fewer species. In Phase III, the four species recorded are *Acacia* sp., *Albizzia* sp., *Adina cordifolia* and *Soymida febrifuga* (rohini). Of these, the first three have already been mentioned as occurring in Phase II, and it is conceivable that some of the samples which could not be identified from Phase II might well be *Soymida febrifuga*. In Phase IV or the latest occupational period, the only species represented by charcoal samples is *Acacia* sp. Besides the charcoal samples, the highly calcined wooden beam which has similarities with Leguminosae could also possibly be a species of *Acacia* or *Albizzia*.

The six tree species reported above, occur in the different occupational periods only in the form of charcoal. There is no evidence as to whether they were used as charcoal or firewood or in any other form, as practically all of them are useful for various household and constructional purposes.[2] It is also not certain whether they were actually growing in that region or were brought from places with which the inhabitants might have had trade and other contacts. However, the probability is that they were all growing locally in the neighbouring forests and hence easily available to the people of the region. On this assumption a critical analysis of the species occurring in the three occupational periods provides a fascinating basis for speculating on the vegetational and climatic changes that might have taken place in this part of Saurashtra during the last 4 millennia.

The picture of the forest vegetation that one can visualize from the charcoal records at Lothal is no doubt incomplete, but it does give at least a glimpse of the past and also throws some light on the probable changes in climate. At present, according to Champion's classification of forest types the greater part of Saurashtra including the Lothal region comes under tropical thorn forest, in which the characteristic tree species are *Acacias* and their allies.[3] The rainfall excluding the Gir forests averages between 50 and 65 cm decreasing progressively to the north-east and north-west to below 25 cm.[4]

It is interesting to compare this situation with what might have prevailed in the third millennium B.C. as evidenced by the plant remains. In this connection the presence of teak *(Tectona grandis)* in Phase II in the light of its present distribution is highly significant. It may be seen from the map (Fig. 151) that there is at present no teak at all in any part of the Saurashtra region of Gujarat excepting in the Gir area where sometimes the rainfall may be as high as 120 cm. or more. Towards the east, the teak growing areas of Gujarat are to be found mainly in Panch Mahals, Surat and the Dangs extending in the north up to Sabarkanta and Banaskanta.[5] The rainfall in this teak belt generally varies from about 75 to 175 cm being about 110 cm in Panch Mahals. The forest vegetation of the teak growing areas in Gujarat falls under the tropical dry deciduous type.[6] Wherever

[1]R. S. Pearson and H. B. Brown, *Commercial Timbers of India*, I & II. (Calcutta, 1932).

[2]R. S. Pearson and H. P. Brown, *Op. cit.*

[3]H. G. Champion, 'A preliminary survey of forest types of India and Burma'. *Indian For. Rec.* N. S., I, No. 1 (1963) p. 159.

[4]H. R. Desai, 'The forests of Saurashtra', *Indian For.*, 80 (1954), p. 846.

[5]N. S. Kaikini, 'Natural and artificial regeneration of teak', *Proceeding of the Ninth Silvicultural Conference*, (Dehra Dun, 1956).

[6]H. G. Champion, *op. cit.*, p. 129.

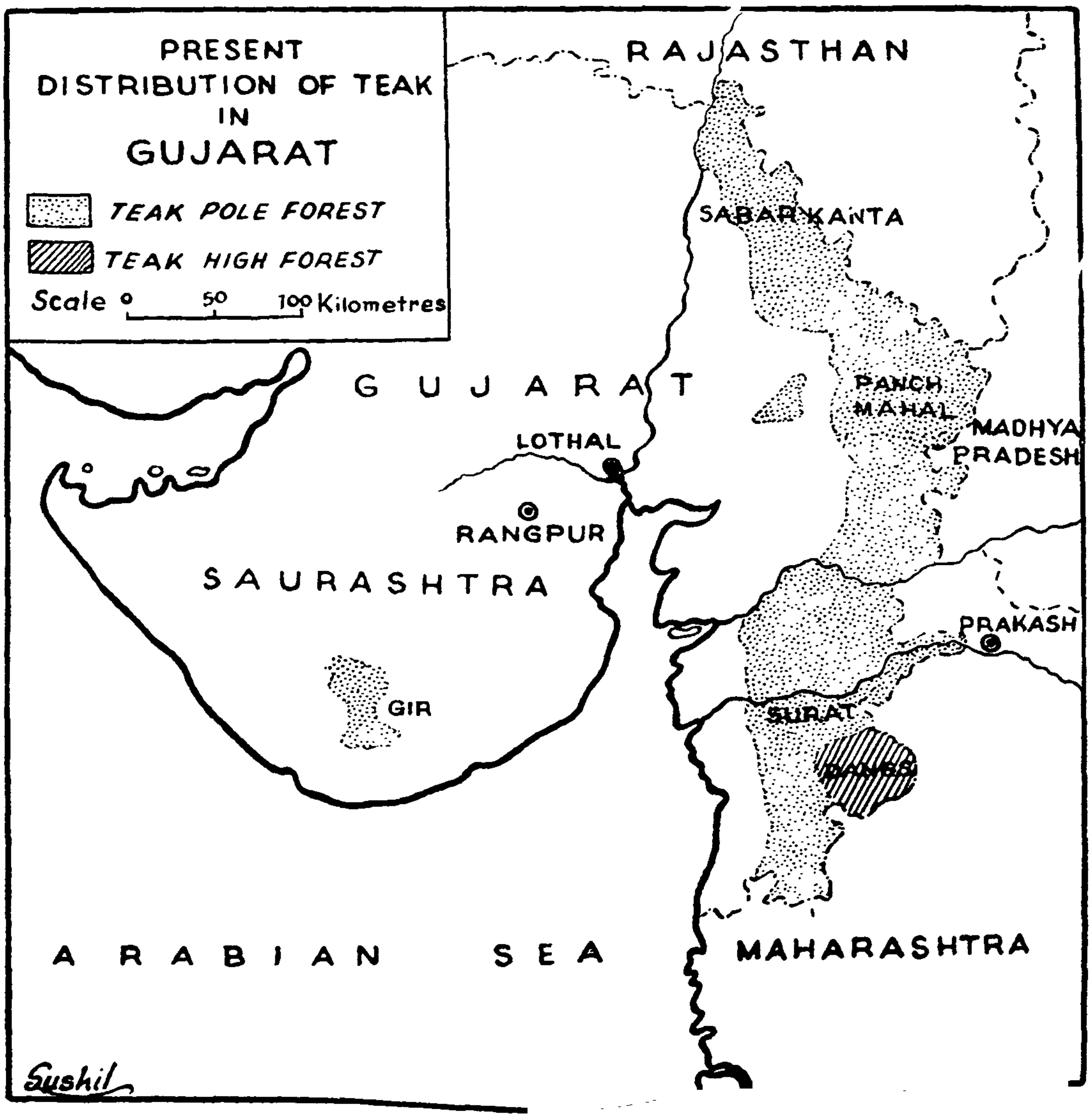
PRESENT
DISTRIBUTION OF TEAK
IN
GUJARAT
TEAK POLE FOREST
TEAK HIGH FOREST
Scale 0 50 100 Kilometres
RAJASTHAN
SABARKANTA
GUJARAT
PANCH MAHAL
MADHYA PRADESH
LOTHAL
RANGPUR
SAURASHTRA
GIR
PRAKASH
SURAT
DANGS
ARABIAN SEA
MAHARASHTRA
Sushil

FIG. 151

the rainfall drops below 75 cm. the dry deciduous teak forests may often merge into the thorn forests.[1]

The occurrence of *Tectona grandis* and *Adina cordifolia* along with *Acacia* and *Albizzia* in the charcoal remains in Phase II, suggests that both the forest vegetation and the climate in the Lothal region at that time may have been different from the present. The forests probably were of the tropical dry (mixed) deciduous type somewhat similar to those occurring in the Gir area and Panch Mahals, indicating a somewhat wetter climate with higher rainfall. The presence of a Lauraceous wood also tends to confirm this. How long these conditions continued can remain at best a matter for conjecture. The absence of teak in Phase III and the occurrence of only *Acacias* in Phase IV, however, shows that at some time or other they may have been followed by a period of drought and progressive desiccation leading to changes culminating in the tropical thorn and desert scrub vegetation of today. This is supported to some extent by the fact that in abnormally dry years teak more than any of its associates suffers from drought. In the Godhra range of Panch Mahals a severe drought in 1900 followed by scarcity of rainfall in subsequent years has been reported as having completely altered both the quantity and silvicultural requirements of the growing stock, in all the forests. The effect of this drought was to damage or kill nearly all species. One of the species most affected was teak of which in places 90 per cent was killed or badly hit. Among the least affected trees were babul *(Acacia arabica)*, hewar *(Acacia leucophloea)*, siris *(Albizzia lebbeck)* and rohini *(Soymida febrifuga)*. In the light of the above, on the probability that the different tree species occurring in the charcoal remains were actually growing at Lothal and its neighbourhood, it will not be too far fatched to infer that prior to about 2200 B.C. the region was more moist and fairly well forested. Sometime later, there was probably a severe drought followed by arid conditions, giving rise to the relatively dry climate and thorny desert scrub vegetation of today.

Plant remains other than charcoal found at Lothal are very meagre and scrappy. Of these, the only material which could be identified with certainty is *Oryza* sp. (rice), which has been recorded from Phase II. The occurrence of rice in the form of impressions of husk and straw with attached fragments of epidermis in burnt clay lumps, suggests that this important food plant was growing and must have been cultivated in the region about 2300 B.C. This is not surprising considering that rice has also been recorded from Rangpur,[2] another Harappan site in Saurashtra. Phase III and IV, have not revealed the presence of any rice. On the other hand, occurrence in Phase IV of a few grains of a cereal probably a mellet, along with impressions of a monocot stem and leaf which could possibly also have been straw of a millet, indicates that drier conditions had already set in. Here it may be of interest to mention that millets are widely cultivated as a food crop in the drier parts of the country including Saurashtra and their straw when plastered with mud yields material suitable for building walls of huts. Finally, apart from throwing some light on the past vegetation and climate, the plant finds discussed above also indicate the existence of a fairly advanced civilization and culture as at Harappa,[3] and Rangpur[4] the people being presumably well conversant with cultivation of food crops, proper utilizat on of wood and building.

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[1]H. G. champion, *op. cit.* p. 130.

[2]S. S. Ghosh and Krishna Lal, 'Plant remains from Rangpur', *Ancient India*, Nos. 18 & 19 (1962 & 1963), p. 168.

[3]K. A. Chowdhury and S. S. Ghosh, 'Plant remains from Harappa 1946', *Ancient India*, No. 7 (1951).

[4]S. S. Ghosh and Krishna Lal, *op. cit.*

6. SUMMARY

1. Plant remains from archaeological excavations at Lothal consisting of charcoal, calcined wood, impressions on clay lumps and some seeds have been examined.

2. The material studied belongs to three occupational periods ranging from *circa* 2350 B.C. to 1900 B.C.

3. In all six different types of wood have been identified from the charcoal remains viz. *Acacia* sp. *Albizzia* sp., *Tectona grandis, Adina cordifolia, Soymida febrifuga* and a Lauraceous wood.

4. The clay impressions have yielded *Oryza* sp. and an undetermined monocot, while the seeds are probably of a millet and *Sesamum indicum.*

5. The significance of the occurrence of the different species in the various occupational periods has been discussed in the light of the present-day vegetation and climate of the region, and an attempt made to indicate changes that might have taken place during the last 4300 years.

7. ACKNOWLEDGEMENTS

Our grateful thanks are due to the Director General of Archaeology in India and Shri S. R. Rao, Superintending Archaeologist, Archaeological Survey of India, who carried out the excavations, for giving us an opportunity to study these valuable materials. To the latter we are especially indebted for sending us useful information on the excavation and detailed particulars of the plant remains. We also wish to place on record our appreciation of the assistance given in the laboratory by our colleagues Km. P. G. Pattanath and Shri R. Shahi of this Institute.

8. EXPLANATION OF PLATES

Pl. CCCI

Acacia Sp.

1. Transverse section of charcoal, showing predominantly solitary vessels and vasicentric parenchyma (X43).
2. Tangential section of charcoal, showing the size, structure and arrangement of rays (X60).

Albizzia sp.

3. Transverse section of charcoal, showing prominent but poorly preserved aliform parenchyma (X43).
4. Tangential section of charcoal, showing ray size and distribution (X60).

Pl. CCCII

Tectona grandis Linn. f.

1. Transverse section of charcoal, showing ring-porous character and collapsed earlywood parenchyma (X43).
2. Tangential section of charcoal, showing rather badly preserved rays with homocellular to some what heterocellular structure (X60).

Adina cordifolia (Rosb.) Hk.f.

3. Transverse section of charcoal, showing very numerous small vessels and diffuse to diffuse-aggregate parenchyma (X43).

4. Tangential section of charcoal, showing narrow, closely-spaced heterocellular rays (X60).

Pl. CCCIII

Soymida febrifuga A. Juss.

1. Transverse section of charcoal, showing vessels with dark contents, parenchyma bands delimiting growth rings and rather coarse broad rays (X43).
2. Tangential section of charcoal, showing high wide and somewhat large-called rays (X60).

Lauraceous wood.

3. Transverse section of charcoal, showing characteristic arrangement of the vessels and large thin-walled parenchyma in association with them (X43).
4. Tangential section of charcoal, showing heterocellular rays (X60).

Pl. CCCIV

Oryza sp.

1. Impression of grain on clay lump showing palea, fertile lemma and longitudinal groove separating them (Natural size).
2. Impressions of rice straw on clay lump (Natural size).
3. Epidermis of husk, showing long dagger-shaped hair and silica cells (X200).
4. Epidermis of husk, showing the characteristic zig-zag pattern of cells (X200).
5. Epidermis of husk showing silica cells and portion of hair (X200).
8. Epidermis of leaf showing two intercostal rows of short cells with prominent 'Oryzoid' silica bodies separated by a median intercostal region with distinct long cells having 'V' pointed wavy margins (X200).

Calcined geam

6. Isolated fragment showing four vessel elements with pitting (X63).
7. Vessel wall showing bordered pits with lenticular orifice and vestures (X400).
9. Vessel element showing simple perforation (X80).
10. Radial view of isolated fragment with some of the calcium carbonate not removed, showing part of a ray and some fibres (X63).

APPENDIX I

Overseas trade in ancient India

India began her sea-borne trade with the very beginning of recorded time. The *Rig-Veda* contains several references to sea voyages undertaken for commercial and other purposes. One passage (I.25.7) represents Varuna as having a full knowledge of the ocean routes along which vessels sail. Another (II.48.3) speaks of merchants under the influence of greed, sending out ships to foreign countries. A third passage (I.56.2) mentions merchants whose field of activity knows no bounds, who go everywhere in pursuit of gain and frequent every part of the sea. The fourth passage (VII. 88.3. and 4) alludes to a voyage undertaken by Vasistha and Varuna in a ship skilfully fitted out and they are said to be "undulating happily in the prosperous swing". The fifth, which is the most interesting passage (I.116.3), mentions a naval expedition on which Tugra the Rishi king sent his son Bhujyu, against some of his enemies in the distant islands. Bhujyu however was ship-wrecked by a storm, with all his followers, on the ocean "where there is no support, no rest for the foot or the the hand" from which he is rescued by the twin brethren, the Asvins, in their *hundred-oared galley*. Among other passages mention may be made of one which invokes Agni thus "Do thou whose countenance is turned to all sides send off our adversaries as if in a ship to the opposite shore; do thou convey us in a ship across the sea for our welfare".

The *Rāmāyaṇa* also contains several passages which indicate the intercourse between India and the distant lands by way of the sea. One of them refers to the Yavana Dvīpa and Suvarṇa Dvīpa, which are usually identified with the islands of Java and Sumatra of the Malaya Archipelago.

There is also a reference to *Lohita Sagara* or the Red sea.

Several passages in the *Mahābhārata* refer to the sea and sea-voyages. The *Sabhā Parva* states how Sahadeva, the youngest brother of the five Pandavas went to several islands in the sea and conquered the Mlechcha inhabitants thereof. Baudhayana (*Dharma Sutra*: ii 2.2) forbids orthodox Brahmins from undertaking sea voyages and prescribes a severe panacea for transgression of the prohibition; but he admits (*Dh. S.* i.2.4) that such transgressions were common among the Northerners or strictly speaking, the Aryans living north of the author's home in the Dravidian districts. The same author[3] (*Dh. S.* i. 18.14,) and Gautama (X.33,) fix also the duties payable by shipowners to the king. An interesting passage from Manu's code refers to what may be called marine insurance holding the sailors collectively responsible for the damage caused by their fault to the goods of passengers, and another passage absolves them of all responsibility for loss caused due to accident.

According to Dr. Sayce the commerce by sea between India and Babylon must have been carried on as early as 3000 B.C.[4] when Ur Bagas the first King of United Babylonia ruled in Ur of the Chaldes. This is said to have been attested by the finding of Indian teak in the ruins of Ur. Mr. Hewill is of the view that this wood must have been sent by sea from some port on the Malabar coast. Again Dr. Sayce points to the use of the word *Sindhu* for muslin in an old Babylonian list of clothes as the clearest proof "That there was trade between Babylonia and people who spoke an Aryan dialect. The *Baveru Jataka* relates

[1]Pliny, *Natural History,* xii, 18. See also Mommsen's *Provinces of the Roman Empire,* vol. ii, 299-300.

[2]V. A. Smith *Early History of India,* p. 24.

[3]"The duty on goods imported by sea is, after deducting a choice article, ten Panas in the hundred" (Buhler's translation in S.B.C).

[4]Note:—This date is now modifieds.

the adventures of certain Indian merchants who took the first peacock by sea to Babylon. The Jataka itself may go back to 400 B.C., but the folk-tale on which it is based must be much older. Buhler says that the Vanias of Western India undertook trading voyages to the shores of the Persian Gulf in the fifth, perhaps even in the sixth century B.C. Suparaka and Bharukaccha are two important ports in the 6th-5th century B.C. Indian rice and peacock were common by 430 B.C. in Athens.

Dīgha Nikāya (5th cent. B.C.). refers to "ocean-going ships out of sight of land".

According to Lenormant, the bas-reliefs of the temple of Demi-el-Bahari at Thebes represent the conquest of the land of Punt under Hatasu. "In the abundant booty loading the vessel of the Pharaoh for conveyance to the land of Egypt appear a great many Indian animals and products not indigenous to the soil of Yemen, elephants' teeth, gold, precious stones, sandal-wood and monkeys". Further, according to Wilkinson, the presence of indigo, tamarindwood and other Indian products have been detected in the tombs of Egypt. Prof. V. Ball says "Even in the Mosaic period (1491-1450 B.C.) precious stones which were to a great extent a speciality of India and the neighbouring countries appear to have been well known and were already highly valued. According to the Book of Genesis, in the days of Solomon (1015 B.C.) India alone could supply ivory, garments, armour, spices and peacocks which found customers in ancient Syria. There are also other Biblical allusions to the Phoenicians and Solomon's servants being accompanied in their ships from the mouth of the Indus to the Malabar coast by the Aryan merchants. Herodotus also refers to the precious stones. Pliny (177 B.C.) calls India the sole mother, the great producer of the most costly gems.

For the purpose of the famous voyage of Nearchus down the rivers and to the Persian Gulf a stupendous fleet was built numbering according to Arrian, about 800 vessels (according to Ptolemy 2000 vessels) entirely of Indian wood by the hands of Indian craftsmen.

Further, we have the actual mention made by Arrian of the construction of dockyards, and the supply by the tribe called Xathroi of galleys of thirty oars and transport vessels which were all built by them.[1] From the literary evidence available for the pre-Maruyan period the following list of major items of imports and exports may be drawn.

Imports

1. Frankincense from Arabia
2. Copper and tin from Persia
3. Mother of pearl etc., from Mannar.
4. Gold from Persia exchanged for silk by weight.

Exports

1. Cotton fabric ranging from coarse canvas to Muslin.
2. Beads of semi-precious stones.
3. Ivory and shell.
4. Peacock and monkey.
5. Silk and silk-garments.
6. Drugs and aromatics.
7. Dyes-indigo.
8. Wood-tamarind, teak and sandalwood.
9. Spices-pepper, cinnamon etc.,
10. Musk.
11. Resinuous gums.
12. Coloured carpets.

[1]Anab., vi. 15 and Curtius, is. 9.

Bahrain :

Among various items of Dilmun trade, copper, ivory, gemstones, beads and wood are important for the purpose of considering trade contacts between Bahrain and the cities of the Indus civilization. With the discovery of Bahrain seal at Lothal in which a dragon flanked by jumping gazelles is shown, it became obvious that Lothal had direct trade link with Bahrain in the last quarter of the third millennium B.C. This is further attested by the discovery of six seals in Bahrain and Oman bearing Indus animal motif or script or both. These seals are listed along with other Bahrain seals bearing Indus script in the Louvre Museum by Weisgerber and others. Apparently the Indus merchants who had settled in Bahrain, Oman and Southern Mesopotamia must have been permitted to use their own motifs and writing on the Bahrain type seals for consigning goods to Bahrain or through Bahrain to Sumerian ports. What is significant here is that Bahrain must have insisted on using its distinct round seals to maintain its identity and was at the same time liberal enough to permit the Indus merchants to inscribe their motifs and signs.

Another mechanism of long distance trade is the stone weight. The very fact that the Harappan tetrahedron weights conforming to the Indus standard occur in Bahrain should be an adequate proof of the important role of Harappan traders in Bahrain.

The cargo list of Dilmun merchants included : copper, ivory and beads of semi-precious stones which were very much valued by them. But Bahrain did not produce either carnelian beads or ivory or copper. On the other hand, all the three major items came from other places: beads and ivory from Harappan sites and perhaps copper too, to some extent. The copper from Oman is not arsenic-free according to Weisgerber. Hitherto it was held that the bun-shaped ingot of pure copper (99.81%) of Lothal had come from Oman, but now it appears that Lothal refined copper obtained from Khetri or Oman. Eanasir's letter cited by Oppenheim refers to "good copper" and "ordinary copper". Perhaps by "good copper" is meant absolutely pure copper, free from impurities such as arsenic—If this is so, it is only at Lothal that a pure copper ingot is found. Even the Mohenjo-daro ingots are not arsenic-free (0.15% to 0.8%: arsenic is present) nor are the Oman ingots pure. In that case the purification of copper by remelting and other processes seems to have taken place at Lothal. Out of more than 3000 copper/bronze objects chemically examined and analysed by Dr. B. B. Lal, Chief Archaeological Chemist in India, not a single object contained arsenic. At Lothal there are two furnaces one of which was used for remelting. The corroded sheet-metal lying near the furnace and the terracotta crucibles used in remelting etc. were also found in the excavation. Not far from this furnace is a workshop of copper-smiths wherein 5 pot-furnaces are *in situ*. In the main street of the Lower Town of Lothal there is a coppersmith's workshop in which a stone anvil and bronze tools are found. It is therefore reasonable to conclude that Lothal imported copper ingots, perhaps from Oman or Rajasthan, refined the metal and exported arsenic free copper. The reference made in Eanasir's letter to 'good copper' may be this 99.81% pure copper ingot.

One of the most important items of export from Lothal is carnelian beads. A large bead factory in which beads in various stages of manufacture have been found is laid bare. Two pots embedded in the mud-brick platform of the bead factory contained 800 carnelian beads in various stages of manufacture. Nearby is a double-chambered kiln with four interconnecting flues used for cooking the raw material as well as the finished product. Lothal produced etched carnelian beads also. At the Bahrain and Oman sites typical Indus beads of carnelian and agate have been found. Obviously they must have come from Lothal or Chanhu-daro, the two major bead-making centres of the Indus civilization.

Another important item in the cargo-list of Dilmun merchants was ivory which must

have come from Lothal. An alternate source is the African coast, but other evidences of direct trade link between Bahrain and Oman on the one hand, and the Indus cities on the other, suggest that Lothal or Mohenjo-daro, both of which worked ivory, was the main source. At Lothal an ivory-workshop has been laid bare in the Acropolis, where pieces sawn out of an elephant's tusk are also found. Several types of ivory objects were manufactured here. They include ivory inlays, gamesmen, seals, antimony rods and personal orna-ornaments. The Bahrain goblets and beakers of buff ware seem to be of Indus origin.

The Indus motifs and writing on a few seals of Bahrain and Oman suggest that there was an appreciable number of Indus merchants in the Gulf region. Attention may be drawn to the clay impression of a seal from Bahrain on which heads of six animals including, perhaps, bulls and goats are depicted. This sealing reminds us of a circular seal from Barbar (*see S. R. Rao 1982, The Decipherment of the Indus Script* pl. XL. D.) in which six animal heads (of which three are damaged) are shown. Two are of unicorn and one is of a bull; others are damaged. The Barbar seal has great affinity with the Mohenjo-daro seal. At Harappa there is a circular (Bahrain type) sealing in which the fire god is shown in an arch of flame. Two other seals from Mohenjo-daro depict the fire god and fire-altar. The trade and cultural influence of the Indus civilization over Bahrain and Oman are further attested by the black-on-red and chocolate-or, pink-on-buff painted pottery of undoubted Indus origin found in the Gulf sites. In short, Indus cities were a major partner in the Bahrain trade and the cultural impact was mutual between the two civilizations which is further attested by Indus-Bahrain seal from Bet Dwarka found in sealed excavation.

The ship-models found at Lothal and those actually plying in the sea and Sabarmati estuary today and having 1 to 1.5 m. draft suggest that Lothal ships were 40 to 50 ft long and could carry 60 to 75 tons of cargo. The dockyard at Lothal, the earliest of its kind in the world, could sluice, in its 13 metre wide inlet of the first stage, large boats carrying timber or copper. The perforated stone anchors found in the Lothal dock could be used, according to Honor Frost, on sandy or rocky seafloor.

Lothal, Mohenjo-daro and Harappa were all clean cities noted for baths and underground drainage system. Lothal had a unique dock and warehouse wherein sealings actually used on cargo have been found in large numbers.

We are yet to find a third millennium B.C. a *city* in Bahrain and Oman, in the sense in which the term is applicable to contemporary Harappan cities or in the sense in which it might have been used in the Dilmun epic which says "the holy Dilmun is clean". Father Enki answers Ninsikilla, his daughter..."let your city become the "dockyard house" of the inhabited land'...Dilmun became the dock-yard house"...We are yet to find a dockyard in Bahrain. Lastly we are yet to solve the puzzle : Dilmun is the land where the sun rises. Obviously it must be to the east of Sumer, but Bahrain is to the south. Where are the major habitation sites of Bahrain? The site where the Portuguese Fort stands on Bahrain island has yielded Kassite period pottery and other artifacts. A major part of it might have been submerged by sea during the Second Holocene transgresion even as the holy cities of Bet Dwarka and Dwarka on the west coast of India (Gulf of Kutch) were submerged by the sea in the 14th century B.C.[1] It is worthwhile investigating whether an ancient port lies submerged on Bahrain coast especially when a similar phenomenon in the Gulf of Kutch has been confirmed by Marine Archaeology.

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[1]S. R. Rao 'The Submergence of Dwarka is a fact' in *Jnāna Jyoti,* Bangalore 1984.
do 'Five Lives of Dwaraka' in *Science Age* August 1983 Bombay.
do 'Sunken Ships and Suburged Ports in *Science Today* Sept. 1983, Bombay.
do 'New Light on Epic Dwarka' *The Hindu* Febr. 1985.

APPENDIX II

Indus Engineering, Metrology and Astronomy

Engineering :

There are two aspects of the development of science in relation to the development of society in a particular period. The need of development of science itself in harmony with social interests is one aspect, the other being the preconditions and possibility of the society to develop itself in accordance with the attained level of scientific learning. Four thousand years ago the Indus Civilization was attempting to develop science and technology including engineering in harmony with its ideal of an integrated and peace-loving society with equal concern for material comforts and spiritual progress. The Lothal residents had to meet the challenge of nature in the form of floods from the overflowing rivers which not only inundated their fields but also posed a threat to their towns and cities. Their engineers had to exert themselves in devicing anti-flood measures such as peripheral walls protecting the settlement with as much economy in the use of mud bricks as possible. They were essentially gravity walls 13 m thick at the base and tapering to 12 m at the top in Lothal. Where a nalla or river directly affected the safety of the wall a revetment of kiln-fired bricks was provided. The houses, warehouse and Ruler's mansion were all built over artificial platforms to keep them safe over normal flood level[1]. The experience gained in building gravity walls was useful in Late Harappan times to prevent sea erosion by constructing massive stone walls recently noticed in offshore and onshore excavation of Bet Dwarka. Gravity walls of stone have been found in Kotada (Dhola Vira) and Netra Khirasar, two Harappan towns on the northern border of Kutch. The *Gabar bands* of Baluchistan and water channels of Sabarmati estuary, mostly lying buried now under flood deposit, must have facilitated irrigation besides controlling floods.

The prosperity of the Indus people depended not only on agriculture but also industry and trade. They had to ensure regular supply of wood, metals, precious stones, conch shell, a substitute for corrosive metals, and ivory to feed the manufacturing industries and at the same time make sure of distribution of raw materials and agricultural and industrial products to every nook and corner of the vast empire. The efficiency of the central and local administrative units can be judged from the fact that even the smallest village could get metal and stone implements, steatite ornaments and beads of semi-precious stones, some of which were manufactured from imported raw materials. The sea also threw a challenge to engineers and meteorologists. A proud achievement of the Harappan engineers is the construction of a unique tidal dock which facilitated berthing ships and handling cargo at Lothal, the major international port of the Indus Civilization. Internal and international trade had to be regulated through convenient mechanisms of long distance trade such as weights, measures and seals. Suitable colonies were established at the source of raw materials in Northwest and South Gujarat for precious and semi-precious stones, in Kutch and Bet Dwarka for conch shell, in Afghanistan for metals besides a number of trading stations and manufacturing centres. All these gradually expanded into large provinces.

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[1]S. R. Rao : 'Indus Cities : Planning for Perfection' in *Science Today* June, 1982.

Lothal Dock (2350-2000 B.C.) :

Dr. N. K. Panikkar who had personally examined the dockyard of Lothal, says "The tides, an important phenomenon, are of 'the ebb and flow' of the coastal waters of Kathiawar, anp the Harappan were the first to utilise the phenomenon effectively for berthing ships in the dockyard which they had constructed at Lothal, Ahmedabad District of Gujarat". He adds....

"As already mentioned, Harappans were the successful originators in making full use of the tides at Lothal where they had constructed a dock for developing coastal as well as overseas trade. The basin of the dock, trapezoidal in plan; measures 219 metres north-south and 38 metres east-west. The four embankment walls are constructed out of kiln-fired bricks, the original height being 4.15 metres. However, the present height is only 3.3 metres. Ships entering the Gulf of Cambay had to be moored along the river on the western side of the town and sluiced into the basin at high tide through the inlet channel which was 12 metres wide. It joins the northern embankment to enable large ships to have easy manaeuvarability. During floods in 2000 B.C. (dating by C 14 method) the mouth of the river was silted up and shifted its course to the east of the town thus necessitating the digging of a new channel, 2 metres deep and 2 km. long, to connect the dock with the sea through the river. It joins the eastern embankment at the inlet gap which has the same width as the inlet channel. A spillway with a 1.5 metre-thick wall was built at right angles to the southern embankment wall to allow excess water to escape.

"Ships had to enter and leave the basin at high tide when the water level was maintained sufficiently high above the inlet sill. The easy flow of water at high tide ensured desilting of the basin. The scouring effect of the tidal waters was arrested by the construction of two buttress walls one on either side of the inlet gap. To counteract the thrust of water inside the basin the enclosure walls were buttressed on the outer surface with a 12 to 13 metres wide platform of mud-bricks. The problem of ensuring flotation of ships at low tide was solved by closing the spillway, inserting the wooden shutter in the grooves (Rao 1962, pp. 15-19). Some significant technical details about the dock may be noted here. 'The minimum water-column in the basin was about 2 metres at low tide, the maximum being 3.5 metres at high tide. It is observed that boats of 60 to 75 tons capacity and 20 to 25 metres in length could enter the dock' (Rao 1970, p. 87). Another notable point brought in the study by Rao is that the Lothal dockyard had features which in terms of height, width and length compare favourably with the modern dockyards of Bombay and Visakhapatnam.

"We may affirm, therefore, on the basis of studies made regarding Lothal that this dock was purely tidal and the Lothal engineers had possessed a knowledge of the tidal effects, the amplitude, erosion and thrust. From this knowledge they developed a competence at Lothal for receiving ships at high tide and ensuring flotation of ships inside the dock at low tide" (Panikkar and Srinivasan, 1970)[1].

Communication of thought through Simplified writing :

Scientific progress and technological development mentioned above could be achieved by the Harappans because of the disciplining of a partly pictorial-cum-cursive

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[1]N. K. Panikkar and T. M. Srinivasan "Early Concepts of Oceanographic Phenomena of the Indian Ocean" in *Proceedings of the Royal Society of Engineers* (B) 72, 24, 1971/72, pp. 269 *ff.* (1972). Also Panikkar N. K. and Srinivasan T. M., 1971 'The Concept of Tides in Ancient India' *Indian Journal of History of Science* 6 (1).

writing into a pure cursive alphabetic writing (Fig. 36 C, pp. 213) and the reduction in the number of signs to 22 from 62, the latter including pictures of animals, birds, insects, plants and other objects. The former writing is designated cursive and the latter, of 62 signs, as hieratic. Both had phonetic values, but the hieratic, which is earlier in date, used syllables and some single—sound signs besides a few logosyllables. But the cursive writing was purely of single-sound signs and in that sense it was alphabetic with clear distinction of consonants and initial vowels. Two peculiarities of early Indus writing, namely formation of conjunct consonants and attaching short strokes (diacriticals) to basic signs for indicating vowel variations continued in the cursive writing also, as shown in fig. 15A. The identification of basic cursive signs in the inscriptions of the early as well as later writing is not difficult as can be seen in Figs. 153 and 154.

With an easy writing technique and an efficient distribution system the Harappans could speed up progress in industry, commerce and development of social and political institution, without employing force. Peace brings prosperity especially when there is discipline among the rulers and the ruled. This discipline was not only external as attested by administration but also internal through yoga.

Metrology, mathematics and astronomy :

The Harappans developed a good degree of skill in their measuring computational techniques which enabled them to achieve proficiency in town-planning and architecture, which was their immediate need, besides enforcing a rational system of weights and measures. The accuracy and uniformity of denominations and shapes of stone (agate and chert) weights used over the length and breadth of the vast country that came under the Harappan influence for nearly a thousand years have no parallels in the history of metrology in the world. Even as recently as 1950 there was chaos in the metrology of India. It is being rectified by the introduction of the metric system which the Lothal rulers had used and perhaps invented more than 4000 years ago.

Hemmy had analysed the Indus cubical (hexahedron) weights in 1938 and arrived at a binary system. He considered 13.731 g. as the Indus unit[1]. The present author separated the hexahedron weights of Lothal from the truncated spheroid weights from the same Harappan site and pointed out that there were two systems in vogue, the binary for international use and the decimal for internal use.[2] Subsequently V. B. Mainkar, Director of the Indian Standards Institution, New Delhi has taken together all the Indus weights of Harappa, Mohenjo-daro and Lothal and divided them into two logical groups as shown in Table XXXII and Table XXXIII.[3]

In the First Series *27.584* g. is lower unit. Its smaller denominations are in decimal divisions 0.05, 0.1, 0.2, 0.5, and larger denominations 2, 5, 10, 20, 50, 100, 200, 500.

Mainkar remarks that "these two tables are formulated by the application of the same logical principle as has been used 4000 years later in the progression of the denominations of the weights of the metric system.... The weights of ratio unity in the two tables are related to each other". The unit weight of 27.584g of the first series is 50% higher than the unit weight 18.1650g. of the second series. The first series seems to have been used for internal transactions and the second for weighing export commodities. "But the later history

[1]Hemmy in J. Marshall : *Mohenjo-daro and the Indus Civilization,* II 1931, p. 589 *ff.*

[2]S. R. Rao, *Lothal and the Indus Civilization* 1973

[3]V. B. Mainkar 'Metrology in Indus Civilization' in B. B. Lal and S. P. Gupta (Ed) *Frontiers of the Indus Civilization* (1984) p. 141 *ff.*

TABLE—XXXII

DENOMINATIONS AND RATIO

Denomination of weights in Mean Weight

Mean wt. (grammes)	Ratio
0.871	1
1.770	2
2.285	8/3
3.434	4
6.829	8
13.731	16
27.405	32
54.359	64
136.02	160
164.50	200
271.33	320
546.70	640
etc.	
2701.4	3,200
10865.0	12,800

TABLE—XXXIII

FIRST SERIES WEIGHTS

Weight (grammes)	Ratio	
1.2184	0.05	
2.285	0.1	
5.172	0.2	
13.792	0.5	
27.584	1	lower unit wt.
55.168	2	
137.90	5	
271.33	10	Higher unit wt.
546.70	20	Higher unit wt.
1417.5 etc.	50	Higher unit wt.

TABLE—XXXIV

SECOND SERIES WEIGHTS

Weight (grammes)	Ratio	
0.871	0.05	
1.770	0.1	
3.434	0.2	
8.5753	0.5	
18.1650	1	*lower unit wt.* (1½ times is 27.584 in First Series).
33.3052	2	
174.50	10	
6930.00	500	(?)

TABLE—XXXIV

GOLE DISCS THIRD SERIES WEIGATS

Weight of Lothal gold discs
50 mg = dhānya = ½ gunja
100 mg = 1 gunja
200 mg
300 mg
500 mg
3250 = 5 gunja = 1 Suvarna mashaka

shows that the second series also may have an indigenous origin. "(Mainkar, 1984). There are usually two basic weights in a series; the lower unit is used for weighing small quantities of precious commodities like silver and gold and the higher unit weight for weighing larger quantities of commodities of daily use, for instance, foodgrains. These units can be compared to 'tola' and 'seer' in vogue in India till recently. The Indus weight of 27.584g. in the first series was, according to Mainkar, the lower unit weight and 546.70g. or 1417g. was the higher unit weight. The smaller denominations are in decimal division of the lower unit weight. The smallest denomination is 0.05 times the unit, the ratio being 1, 2, 5, 10, 20, 50, 100, 200, 500 etc. The higher unit should not be too heavy to handle, that is, not more than 2 kg. In the case of the Indus weight it would be 20:1 or 50:1, that is, 546.70g or 1417.5g.

In 1979 another series of very small weights in the form of gold discs carefully preserved in a pot was found in the building close to the bead factory at Lothal. Table XXXIV gives the weight of these gold weights. The unit in this series is 100mg running in decimals to a large extent. This unit seems to be the correct weight of the *Gunja* as calculated by the Harappan goldsmiths and jewellers. Mainkar has arbitrarily taken 109mg as equal to one *Gunja* because, as he admits, the weight of the *Gunja* varies from region to region and the same *Gunja* varies in weight according to season ranging from 105 to 120mg. The Harappan gold disc weights, however, give not only the weight of the *Gunja*

but also of *half Gunja* which is called *dhānya mashaka* in the *Arthaśāstra*. The term *maśaka* appears in the Indus seals also. According to the *Arthaśāstra*, 5 *Gunjas* are equal to one *suvarna mashaka*. The same text prescribes a different series for weights of gold, silver and diamonds. The *mashaka* was made in the ratio of 1/2, 1, 2, 4, 8 and *suvarṇa* in 1, 2, 4, 8, 10, 20, 30, 40 and 100. The Unit, 100mg of Lothal gold disc-weights, runs in the ratio 1/2, 1, 2/5, 5, 10, 25, 27.5, 28, 29, 30 and 32.5. There is one weighing 1300mg. By and large, the smallest series weight meant for weighing precious metals and diamonds runs in decimal denominations. Some intermediary weights may be missing. According to Mainkar, the *karsha* or *suvarṇa* (8.720gm) of *Arthaśāstra* related to the weight of 8.575g in the second series of Indus weight and the *droṇa* of 6976g. to the Indus weight of 6930g. The difference is due to the fact that Mainkar has taken *Gunja* as equal to 109mg. instead of the more accurate wight namely 100mg. as attested by the Lothal third series which came to light in 1979-80. Though the decimal progression of Indus weights is not so strong in the *Arthaśāstra* weights, the latter is not binary either.

The lower unit weight of 27.584g. of Indus series is related to the Greek *Uncia* of about 27.2g. It is most likely that the Greek *Uncia* was modelled on the lower unit weight of 27.584g. of the Mature Harappan period or 26.611g. of the Late Harappan times. In this connection attention may be drawn to the decimals multiple 1 to 10 mentioned in the *Yajurveda* (Ch. 17, Verse 2.) and the logical use of the decimal system in the Indus Civilization.

Length measure :

The fragmentary shell scale from Mohenjo-daro shows 9 graduations. There is a hollow circle on one graduation, and on the fifth from it, a circular dot is marked. The length contained between the hollow circle and dot is 33.528mm. It follows therefore that the length between two hollow circles would be 67.056mm. "Since the subdivision of major graduation on the broken scale is decimal the full scale must have had 10 major graduations giving a total length of 670.56mm. Another linear scale of the Indus civilization comes from Lothal. Though broken and only 27 divisions are visible on this scale made of ivory, it is notewothy that the sixth and twentyfirst graduation lines are longer than the rest clearly indicating a decimal division. The length over the twentyseven divisions visble on the scale is 46mm. giving an average of 1·704mm. Though the Lothal and Mohenjo-daro scales appear different owing to the smaller divisions of the former, the two are integrated, for, 4 divisions of Lothal scale are equal to one division of Mohenjo-daro scale (6.706mm). The smallness of Lothal graduation suggests that the scale was used for finer measurements such as the Indus seals, compass etc. As regards accuracy the calculated distance of 68mm (Lothal 40 divisions) being equated to the actual distance of 67 mm (on Mohenjo-daro scale), there is no substantial error, because it is difficult to read with the naked eye the graduation lines separated by 1 mm. and must have been much more difficult to draw them 4000 years ago when modern mechinery was not available.

The most interesting part of the integrated Lothal and Mohenjo-daro scales, which we may call the Indus scale, is the ample evidence of its practical use. The Indus bricks were manufactured in the most practical and logical ratio of Length, Breadth, Thickness 1:1/2:1/4; Lothal 280 × 140 × 65 mm; Kalibangan 400 × 200 × 100 mm; Mohenjo- daro and Kalibangan 300 × 150 × 75 mm. The longest side of Mohenjo-daro brick (225 mm) is 9 times the major graduation (25.6 mm) of Lothal scale and the longest side of Lothal brick (250 mm) is equal to 10 major graduations or, within limits of error, equal to 50 small graduations. The brick with 300 mm side is almost equal to 12 large Lothal graduations

(25.56 × 12). Obviously the bricks were manufactured in dimensions which were integral multiples of large Lothal graduations.[1]

The average measurements of the dock at Lothal are 214 m × 36 m, and the foundation is 1.78 m wide, the wall above ground being 1.04 m. It is of great significance to note that 1.40 m is equal to 40 large graduations of Lothal scale and 1.78 m is 1000 times the small graduation (1.7 mm) The major dimensions of the dock are in the proportion of 6:1. The width of the dock, namely 36 m is 20 times the width of the foundation, namely 1.78 m which is related to the small graduation on Lothal scale by being 1000 times 1.704 mm. The width of Lothal and Mohenjo-daro doors is 1.02 m, that is, 40 times the large Lothal division 25.56 mm. Numerous other dimensions and measurements reveal the rationality and accuracy of the integrated Indus scale. Further, the value 17.78 mm of the *angula* of the *Arthaśāstra* (basic unit) calculated by Manikar is almost equal to ten small graduations on the Lothal scale, namely 1.704 × 10 mm. On this basis the entire series of length measures specified in the *Arthaśāstra* agrees with the pattern of the Indus scales.

Area Measures :

Some interesting calculations on area measures in the Indus Civilization have been made by Brij Bhusan Vij[2] who observes "The Indus Civilization achieved perfection in its measuring technology and high standardisation in preservation techniques. The material evidence also suggests that the ideas of the circle and angle and also the ratio between the circumference to the diameter of the circle was known to this culture. The dimensions to which the Great Bath—discussed later—had been constructed leave no doubt in the mind of the author that the idea of angles and their trigonometric functions were within their speculative imagination. It would also follow that the knowledge of the value of *Pi* or *Π* to the culture of the Indus valley cannot be discarded. If this be so, what was the ratio of the circumference to the diameter of the circle? Did the ancient culture rationalize the angle 'radian' and assign it any specific value? Perhaps yes."

Citing the following facts, Vij observes that "the Indus Civilization certainly knew the realistically 'exact' value for the ratio *Pi* and hence the measured dimension of the circumference of the earth was within their technological capability."

"(a) The existence of a few objects believed to be instruments used to determine the position of the star; also the prediction of astronomical phenomenon. Such instruments were a positive contribution to the measurement of angles (Rao, 1973; pl. XXXB).

"(b) The existence of the linear measure—Indus unit—whose 30 units closely conform to the present linear scale—metre. A distance of ten such metres work to 32.816 British feet which agree with the actual measurement of 33 feet (Mohenjo-daro and Lothal scales).

"(c) The construction and geometric plan of the Great Bath had its measured dimensions: 46 feet as its base diagonal, 23 feet broad, and 8 feet deep, with the plan area of 100 square yards (all dimensions in British measures). The plan area works to about 85 square metres (new).

"The bath can be interpreted to have been specifically constructed for use as a possible observatory 'rather than a mere community swimming pool'. If the intended dimensions are processed in relation to the application of trigonometric function of angles, astonishing facts come to light.

[1]V. B. Mainkar *op. cit.,* 1984.

[2]B. B. Vij in *Frontiers of the Indus Civilization* 1984 pp. 153 *ff.*

ANGLE
FUNCTION
SINE
COSINE
TANGENT

"ABCD represent the base plan of the Great Bath with its broader side BC—23 feet or 7.01 metre and the diagonal AC—46 feet or 14.02 metre. If the standard dimensions of the bricks used during that age is accepted as 300 × 150 × 75 mm, it will be seen that the length, breadth and depth needed about 40, 24 and 8 brick-lengths respectively. A total of 61,444 such standard bricks would be needed to fill the volume of the Great Bath. This suggests the idea of a right-angled triangle, i.e. the Pythagorus theorem and hence $\Pi/2$ goes back to antiquity; at least to the Indus Valley Civilization. The historical facts also confirm this aspect as evidenced from the statements in the *Āpasthambha, Baudhāyana* and *Kātyāyana Śulbas*... The intention to keep the base diagonal to be twice the broader side also suggests the effort made towards physical evaluation of the value = 3; since AB % 3×BC. It is also possible that they knew the significance of the equation for the circle xx a + b % c . The base plan was thus made to specific fixed angles%/22,%/23 and%/26 representing their trigonometric functions. The longer side, AB, thus worked to the measured dimension of 39.78 feet or 12.124 metres, that is, 3×7.01 . Not only that, the depth of the Great Bath was very carefully chosen to represent an angle /18 between base diagonal and the skew diagonal, i.e. CAE in the figure." Vij concludes (a) The Indus Valley Civilization had an extremely high rating of standardized practices followed in construction technology; (b) The origin of the metric system can be traced as evidenced from the dimensions of the Mohenjo-daro Bath back to the Harappa Culture which had developed the metric-based measurement technology. Evidences also indicate the use of decimal science based on the 'sexagesimal numeration'......

(d) The significance of interlinking *time, angle and hence calendar* in the technology of Indus Civilization becomes obvious."......

(f) The 'great bath' of Mohenjo-daro was scientifically constructed to calculated dimensions indicating the keen sense of mathematics and astronomy...."

Compass : A circular ring-like object of shell with four deep slits each in its upper and lower margins cut in alternate positions was found at Lothal (pl. CCLXXIX). Similar ones are also reported from Mohenjo-daro. Another shell object of the same shape found at Kotada (Dhola Vira) in Kutch has six slits on each of the two margins. By actual use of the Lothal object it was ascertained that the original purpose was to measure angles on a plain surface and in the horizon. The lines passing through opposite slits when drawn on plane surface, cut at 45° in the case of the Lothal compass and at 30° in the case of the Kotada compass. The compass of eight slits can be used for measuring an angle of 45° and multiples thereof, while the compass with 12 slits is useful in measuring an angle of 30° or multiples thereof. Diagrams parallel to these are also noticeable in ancient Greek texts and they are the simplest devices used by the ancient navigator.[1] The shell ring of Kotada could be symbolic of the division of the Zodiac into 12 divisions of 30° each. It appears that the two shell rings under discussion had been invented for measuring the 8 or 12 whole sections of the horizon and the sky, and not merely the line, points or degrees on a plain surface. By joining the line when viewed through opposite slits on the same margin, angles

[1]E. G. R. Taylor (1956, New Edn. 1971, London) *The Haven Finding Art* (1956, New Edn 1971) pp. 4 *ff*

period of the *Yajurveda*. Hence in the Harappan times also the *Krittikas* (Plaeidas) must be a seven-star group. Prof. S. N. Sen observes "The origin of the Indian nakshatra system has been traced to the *Ṛgveda* where the term *nakshatra* has been used both in the sense of stars and lunar mansions. In the former sense it appears in RV.I.50.2, VII.86.1 and X.68.11. In the sense of Lunar mansions at least two *nakshatras*, nemly *Maghā (Aghā)* and *Phalginis (Arjunis)* are mentioned in the 13th verse of the Sun's bridal hymn 85 in *Maṇḍala* X. The Indus seals also mention *Magha*. Agni, being the deity of *Krittikas* in the Vedic hymns, and Krittikas being a group of seven stars, the Indus seal depicting the offering of oblations to the Fire God may suggest that the sacrifice was commenced in Krittika nakshatra.

APPENDIX III

LIST OF HARAPPAN AND LATE HARAPPAN SITES IN GUJARAT

(Fig. 154)

I. *Harappan Sites*
Dist. Ahmadabad
1. Koth 22°38′ N 72° 18′ E
2. Lothal 22°31′ N, 72°15′ E

Dist. Broach
1.2. Bhagatrav 21° 29′ N, 72° 52′ E

Dist. Kutch
1. Desalpur 23° 29′ N, 69° 10′ E
2. Dholavira (Kotadi) 23° 58′ N, 70° 12′ E
3. Kotada Bhadli-1 23° 22′ N, 69° 26′ E
4. Kotada Bhadli-2 23° 2′ N, 69° 26′ E
5. Kotada 23° 17′ N, 70° 06′ E
6. Lakhapar 23° 33′ N, 70° 28′ E
7. Pabhumath 23° 38′ N, 70° 31′ E
8. Samagogha 22° 55′ N, 69° 40′ E
9. Surkotada 23° 37′ N, 70° 50′ E
10. Todio 23° 05′ N, 69° 55′ E

Dist. Surendranagar
1. Rangpur 22° 20′ N, 71° 55′ E

II. *Late Harappan Sites*
Dist. Ahmedabad
1. Akru 22° 15′ N, 71° 55′ E
2. Alau 22° 25′ N, 71° 40′ E
3. Bhimnath 22° 15′ N, 71° 55′ E
4. Bhimpatal 22° 15′ N, 71° 40′ E
5. Chabasar 22° 16′ N, 72° 16′ E
6. Devganga 22° 18′ N, 71° 50′ E
7. Hadmatala 22° 30′ N, 72° 08′ E
8. Kanasutaria 22° 47′ N, 72° 16′ E
9. Metal Mahano Timbo 22° 47′ N, 72° 15′ E
10. Pavteswar 21° 10′ N, 71° 54′ E

Dist. Amreli
1. Bhamakdal 21° 45′ N, 70° 50′ E
2. Bhatiwadi 21° 45′ N, 70° 50′ E
3. Bodiyo 21° 49′ N, 71° 06′ E
4. Devalio 21° 52′ N, 71° 25′ E
5. Dhankanio 21° 46′ N, 70° 55′ E
6. Dhrosan 20° 50′ N, 70° 30′ E
7. Dhuapino 21° 27′ N, 71° 49′ E
8. Kaj 20° 44′ N, 70° 35′ E
9. Kanjetar 20° 45′ N, 70° 40′ E
10. Lakhavav 21° 51′ N, 71° 27′ E

11. Machiala Mota 21° 41′ N, 71° 114′ E
12. Medeva 21° 50′ N, 71° 24′ E
13. Madeva 21° 45′ N, 70° 50′ E
14. Mahadevio 21° 54′ N, 71° 17′ E
15. Neshdo 21° 53′ N, 71° 23′ E
16. Randalio 21° 48′ N, 71° 03′ E
17. Sultanpur 21° 45′ N, 70° 50′ E
18. Tetario 21° 49′ N, 71° 06′ E
19. Vadera 21° 36′ N, 71° 06′ E
20. Vanivadar (Vaniavadar) 21° 39′ N, 71° 09′ E

Dist, Banaskantha

1. Atarnes 32° 40′ N, 71° 20′ E
2. Benap 24° 05′ N, 71° 25′ E
3. Jhekada 23° 50′ N, 71° 25′ E

Dist. Baroach (Bharuch/Broach)

1. Chavaneshwar 21° 41′ N, 72° 48′ E,
2. Hasanpur 21° 33′ N, 72° 46′ N
3. Manar 21° 42′ N, 72° 47′ E
4. Mehgam 21° 42′ N, 72° 45′ E
5. Telod 21° 42′ N, 72° 46′ E

Dist. Bhavnagar

1. Adatala 21° 58′ N, 71° 37′ E
2. Bhojavadar 21° 52′ N, 71° 42′ E
3. Bhoklidhar 21° 58′ N, 71° 38′ E
4. Budhel 21° 41′ N, 72° 09′ E
5. Charanio 21° 52′ N, 71° 38′ E
6. Chosla 21° 53′ N, 71° 34′ E
7. Chota Isvaria 21° 57′ N, 71° 34′ E
8. Cheolo Bund 21° 58′ N, 71° 27′ E
9. Hanuman-no-Timbo 21° 57′ N, 71° 34′ E
10. Halivalo 21° 57′ N, 71° 40′ E
11. Itaria 21° 58′ N, 71° 27′ E
12. Isvaria 21° 58′ N, 71° 42′ E
13. Jivani-no-Dhoro 21° 52′ N, 71° 45′ E
14. Kerlavlo 21° 51′ N, 71° 38′ E
15. Khanderio (Rampara—1) 21° 58′ N, 71° 38′ E
16. Khandario (Rampara—2) 21° 58′ N, 71° 29′ E
17. Khetarvalo 21° 58′ N, 71° 37′ E
18. Khodiyar 21° 24′ N, 71° 09′ E
19. Lakhamka 21° 48′ N, 71° 38′ E
20. Makvana 21° 57′ N, 71° 40′ E
21. Oriyao 21° 54′ N, 71° 32′ E
22. Pasegam 21° 41′ N, 71° 34′ E
23. Phul Timbo 21° 52′ N, 71° 44′ E
24. Phul Wadi 21° 51′ N, 71° 40′ E
25. Rajpipla —1 21° 51′ N, 71° 33′ E
26. do —2 do
27. do —3 do
28. do —4 21° 51′ N, 71° 34′ E

29. do —5 do
30. do —6 do
31. do —7 do
32. do —8 do
33. do —9 do
34. Rampara—1 21° 58′ N, 71° 29′ E
35. do —2 do
36. Ranigam 21° 59′ N, 71° 45′ E
37. Samadhiala 21° 52′ N, 71° 40′ E
38. Seed Farm 21° 57′ N, 71° 36′ E
39. Tatana 21° 58′ N, 71° 39′ E
40. Vadgam 22° 21′ N, 71° 27′ E
41. Valpura 21° 57′ N, 71° 42′ E

Dist. Jamnagar

1. Ali Bada 22° 27′ N, 70° 13′ E
2. Ambalia 1a 22° 56′ N, 69° 44′ E
3. Amra 22° 24′ N, 69° 56′ E
4. Bed 22° 26′ N, 69° 55° E
5. Bet Dwarka 22° 28′ N, 70° 26′ E
6. Bhangor 22° 05′ N, 69° 52′ E
7. Bhoklidhar 21° 58′ N, 71° 38′ E
8. Bhayakhakharia 22° 10′ N, 71° 50′ E
9. Binangari 22° 4′ N, 70° 22′ E
10. Chanderwara 21° 51′ N, 69° 24′ E
11. Gop 22° 01′ N, 69° 56′ E
12. Hariana 22° 36′ N, 70° 15′ E
13. Jaidak 22° 40′ N, 70° 35′ E
14. Kalianpur 21° 50′ N, 69° 50′ E
15. Kotada 22° 12′ N, 70° 22′ E
16. Kotda 23° 14° N, 70° 21′ E
17. Lakhabawal 22° 24′ N, 70° 00′ E
18. Lakhan Timbo 22° 29′ N, 70° 26′ E
19. Mora 22° 26′ N, 70° 14′ E
20. Morpur 22° 16′ N, 69° 48′ E
21. Mulpadar 21° 56′ N, 69° 44′ E
22. Narmana 22° 05′ N, 70° 09′ E
23. Phala 22° 31′ N, 70° 18′ E
24. Pitar 22° 41′ N, 70’ 32′ E
25. Ran parda 21° 55′ N, 69° 30′ E
26. Saudevalio 22° 00′ N, 69° 44′ E
27. Senalo 22° 12′ N, 70° 25′ E
28. Tankaria 21° 55′ N, 69° 28′ E
29. Tarana 22° 43′ N, 70° 27′ E
30. Venkiner 21° 50′ N, 69° 25′ E
31. Virpur 22° 07′ N, 70° 06′ E
32. Wasai 22° 26′ N, 69° 56′ E
33. Dhulkot 20° 50′ N, 71° 02′ E
34. Shrinagar 21° 39′ N, 69° 37′ E
35. Prabhas Patan 20° 54′ N, 70° 24′ E

36. Kindar Khera 21° 48′ N, 69° 33′ E
37. Khambhodhar 21° 45′ N, 69° 35′ E

Dist. Kutch

1. Jhangar 23° 18′ N, 70° 05′ E
2. Kotasar 23° 34′ N, 70° 29′ E
3. Kotada Bhadli 23° 22′ N, 69° 26′ E
4. Kotada 23° 17′ N, 70° 06′ E
5. Luna 23° 40′ N, 69° 15′ E
6. Luna Mandvi 22° 50′ N, 69° 24′ E
7. Navinal 22° 50′ N, 69° 35′ E
8. Pabu Math 23° 38′ N, 70° 31′ E
9. Chitrol 23° 24′ N, 70° 40′ E
10. Ghadwaliwadi 23° 30′ N, 69° 08′ E
11. Gunthai 23° 28′ N, 69° 09′ E
12. Jatavadar 23° 45′ N, 70° 40′ E
13. Kanthkot 23° 29′ N, 70° 29′ E
14. Kerasi 23° 40′ N, 70° 44′ E
15. Khakhra Dera 23° 34′ N, 70° 29′ E
16. Khari-ka-Khanda 23° 27′ N, 70° 19′ E
17. Khedoi 23° 03′ N, 69° 57′ E
18. Kotadi 23° 58′ N, 70° 12′ E
19. Kotara Juni Karan 23° 00′ N, 69° 45′ E
20. Lakhpat 23° 50′ N, 68° 47′ E
21. Marvo 23° 50′ N, 70° 42′ E
22. Narapa 23° 34 N, 90° 05°' E
23. Nenu-ni Dhar 23° 51′ N, 69° 44′ E
24. Pirwada 23° 20′ N, 70° 00′ E
25. Pabhumath 23° 38′ N, 70° 31′ E
26. Rampara (Vekera-no-Timbo) 23° 30′ N, 70° 45′
27. Ramvav 23° 32′ N, 70° 28′ E
28. Samaghoga 22° 55′ N, 69° 40′ E
29. Selari 22° 42′ N, 70° 37′ E
30. Surkotada 23° 37′ N, 70° 50′ E
31. Todio 23° 05′ N, 69° 55′ E
32. Vada 23° 34′ N, 69° 03′ E

Dist. Khera

1. Kerisma-no-Timbo 22° 28′ N, 72° 31′ E
2. Sai-no-Tikro do

Dist. Mehsana

1. Bolera 23° 30′ N, 71° 45′ E
2. Dudkha 23° 32′ N, 71° 46′ E
3. Dhanora 23° 31′ N, 71° 55′ E
4. Dantisana 23° 30′ N, 71° 54′ E
5. Ervada 23° 25′ N, 71° 53′ E
6. Kuwar 23° 32′ N, 71° 37′ E
7. Khandia 23° 32′ N, 71° 45′ E
8. Lalara 23° 33′ N, 71° 47′ E

9. Mahudi 23° 30′ N, 72° 45′ E
10. Manverpur 23° 35′ N, 71° 54′ E
11. Panchasar 23° 25′ N, 71° 49′ E
12. Panva 23° 23′ N, 71° 49′ E
13. Pirozpur 23° 30′ N, 71° 34' E
14. Sibpur 23° 33′ N, 71° 46′ E
15. Sujnipur 23° 53′ N, 72° 05′ E
16. Sushiya 23° 28′ N, 71° 53′ E

Dist. Rajkot

1. Adkot 22° 00′ N, 71° 10′ E
2. Ajmer 22° 40′ N, 70° 50′ E
3. Ardoi 22° 05′ N, 70° 47′ E
4. Belora 21° 48′ N, 70° 26′ E
5. Bhalgam 22° 02′ N, 71° 05′ E
6. Daidungri 22° 00′ N, 71° 05′ E
7. Devdhar 22° 07′ 71° 09′ E
8. Ghorwada 21° 47′ N, 70° 53′ E
9. Ghodhapadar 20° 05′ N, 71° 03′ E
10. Kalapan 21° 55′ N, 70° 20′ E
11. Kerali 22° 50° N, 70° 30′ E
12. Koba 21° 45′ N, 70° 50′ E
13. Kundanpur 22° 05′ N, 72° 10′ E
14. Malgam 22° 01′ N, 71° 26′ E
15. Pitaria 21° 48′ N, 70° 39′ E
16. Rojdi 21° 50′ N, 70° 45′ E
17. Thebachada 22° 16′ N, 70° 50′ E
18. Bhut Kotada 22° 35′ N, 70° 45′ E
19. Dad 22° 50′ 70° 55′ E
20. Dhutapur 21° 50′ N, 71° 00′ E
21. Dumaini 21° 45′ N, 70° 20′ E
22. Dungarpur 22° 71′ N, 71° 31′ E
23. Gadhada—1 22° 26° N, 70° 36′ E
24. Gadhada—2 do
25. Gadhada—3 do
26. Jhikri 21° 55′ N, 70° 50′ E
27. Jodhpur 22° 40′ N, 70° 53′ E
28. Karmar 21° 50′ N, 70° 53′ E
29. Khankhara Bela—1 22° 29′ N, 70° 36′ E
30. Khankhara Bela—2 do
31. Khareda-no-Timbo 22° 05′ N, 70° 48′ E
32. Lukhela 21° 50′ N, 70° 00′ E
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34. Padar 21° 59′ N, 70° 50′ E
35. Pal 22° 18′ N, 70° 43′ E
36. Pithad 21° 57′ N, 70° 44′ E
37. Pithadia 21° 48′ N, 70° 49′ E
38. Rajthali 21° 55′ N, 71° 01′ E
39. Taraghada 21° 50′ N, 71° 28′ E
40. Timaram 21° 53′ N, 70° 30′ E

41. Vadasada 21° 47′ N, 70° 45′ E
42. Vegadi 21° 47′ N, 70° 30′ E

Dist. Surat

1. Malvan 21° 06′ N, 72° 43′ E
2. Navagam 21° 16′ N, 72° 56′ E

Dist. Surendranagar

1. Babarkot 22° 16′ N, 71° 35′ E
2. Chachana 22° 25′ N, 71° 50′ E
3. Devalio 22° 22′ N, 71° 50′ E

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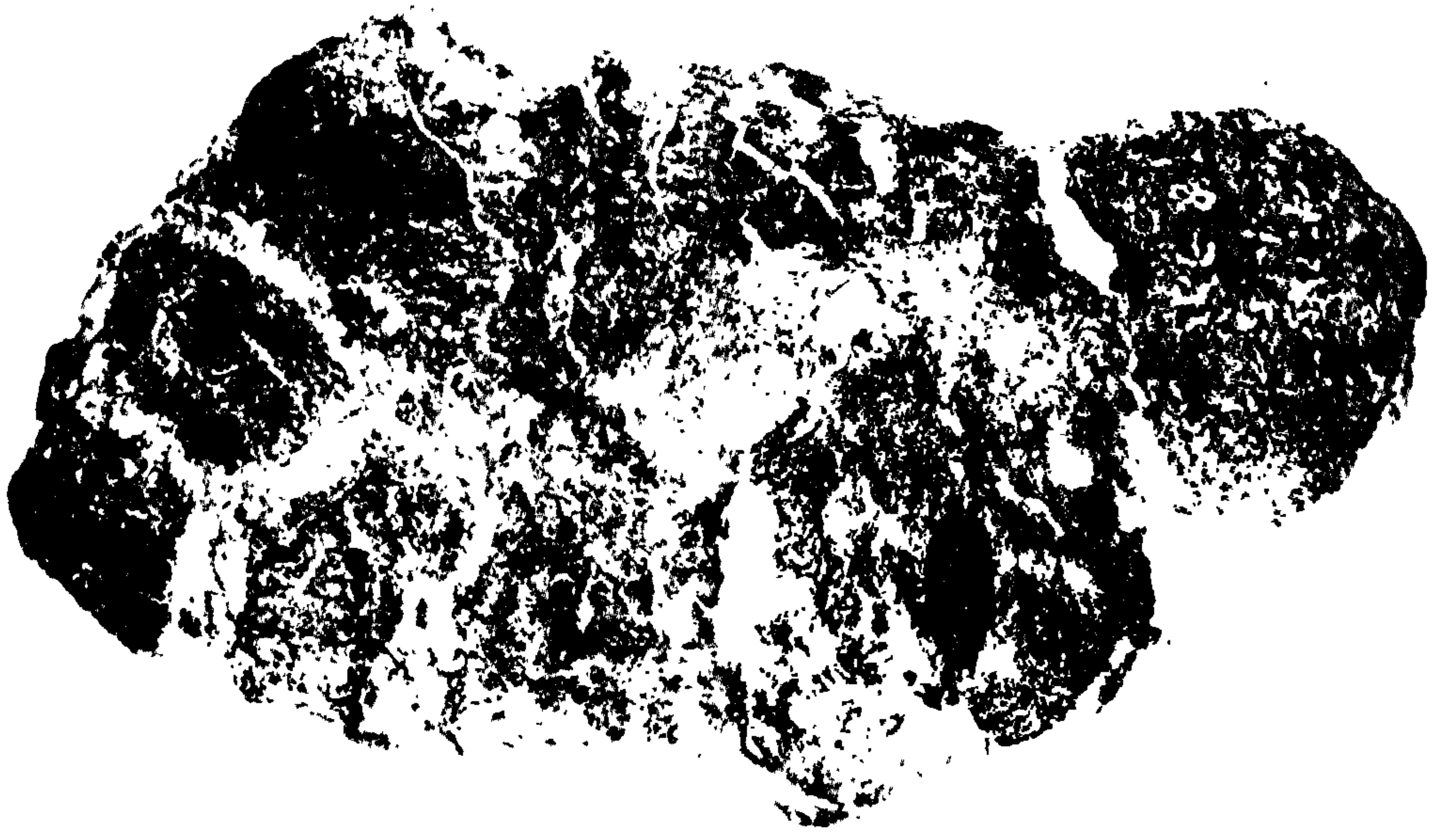
7:041

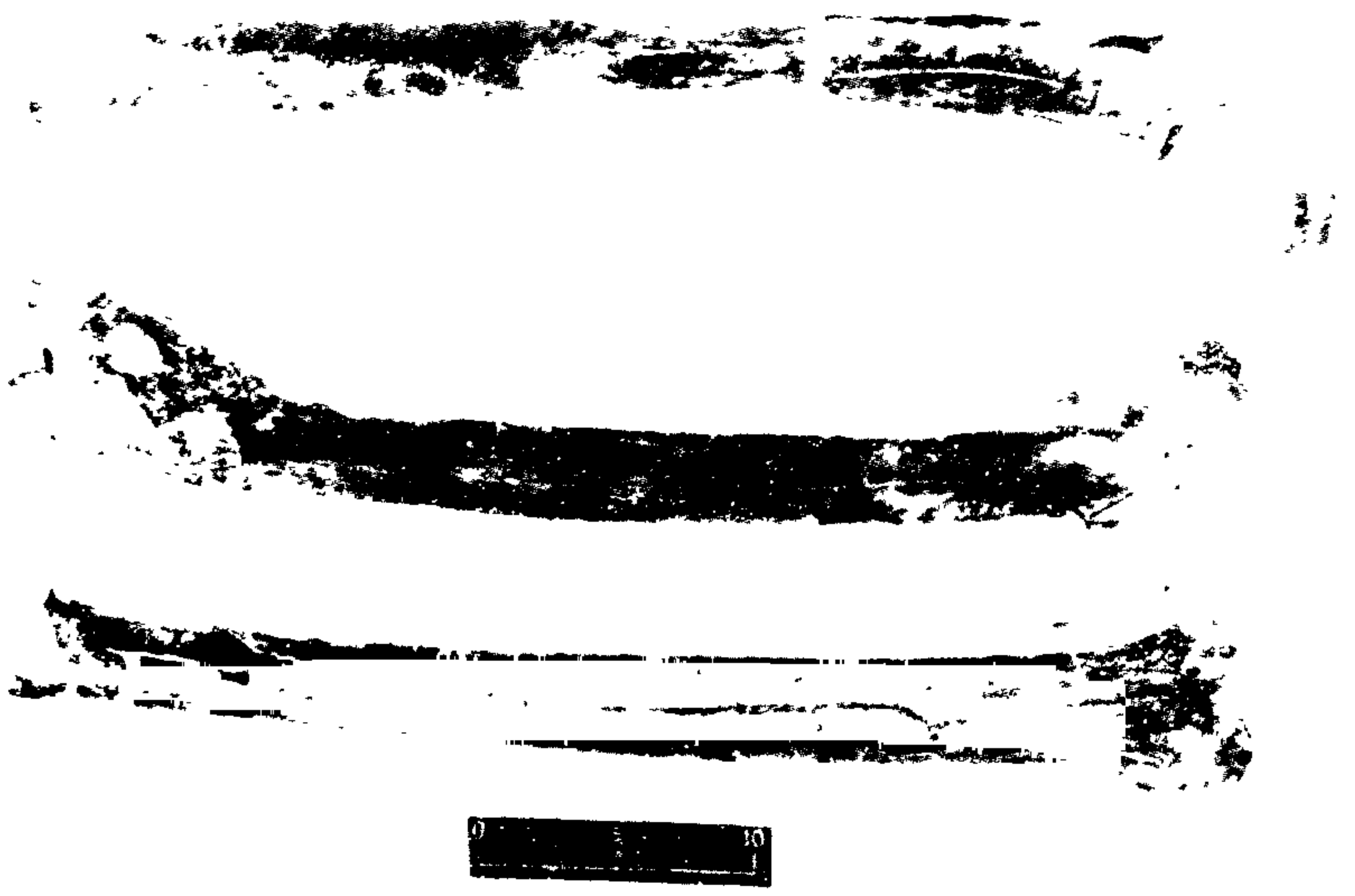
PLATE CXXIX



Foot of skl. no. 11 lifted with venyl acetate showing the action of saltpetre. *See p. 269*

PLATE CXXX

A



B

A *and* B. *Bones of a second individual in association with skl. no.* 16.
See p. 269

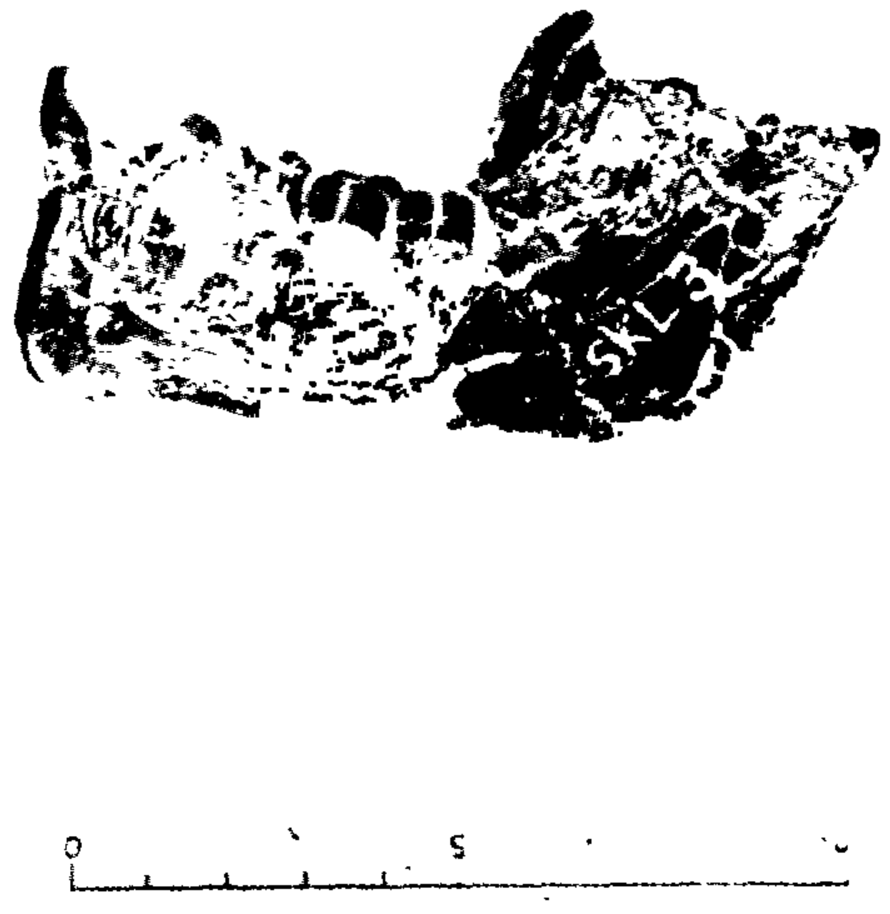
A

B

C

D

A, *Norma basalis of skl. no. 2*; B, *Vertical view of mandible of skl. no. 2*; C, *Side view of mandible of skl. no. 2*; D, *Vertical view of mandible of skl. no. 3.* *See pp. 274 and 275*



A

B

C

A, *Side view of mandible of skl. no. 3* ; B, *Norma facialis of skl. no. 6* ; C, *Norma basalis of skl. no. 6.*
See pp 275 and 276

PLATE CXXXIV

A

B

C

D

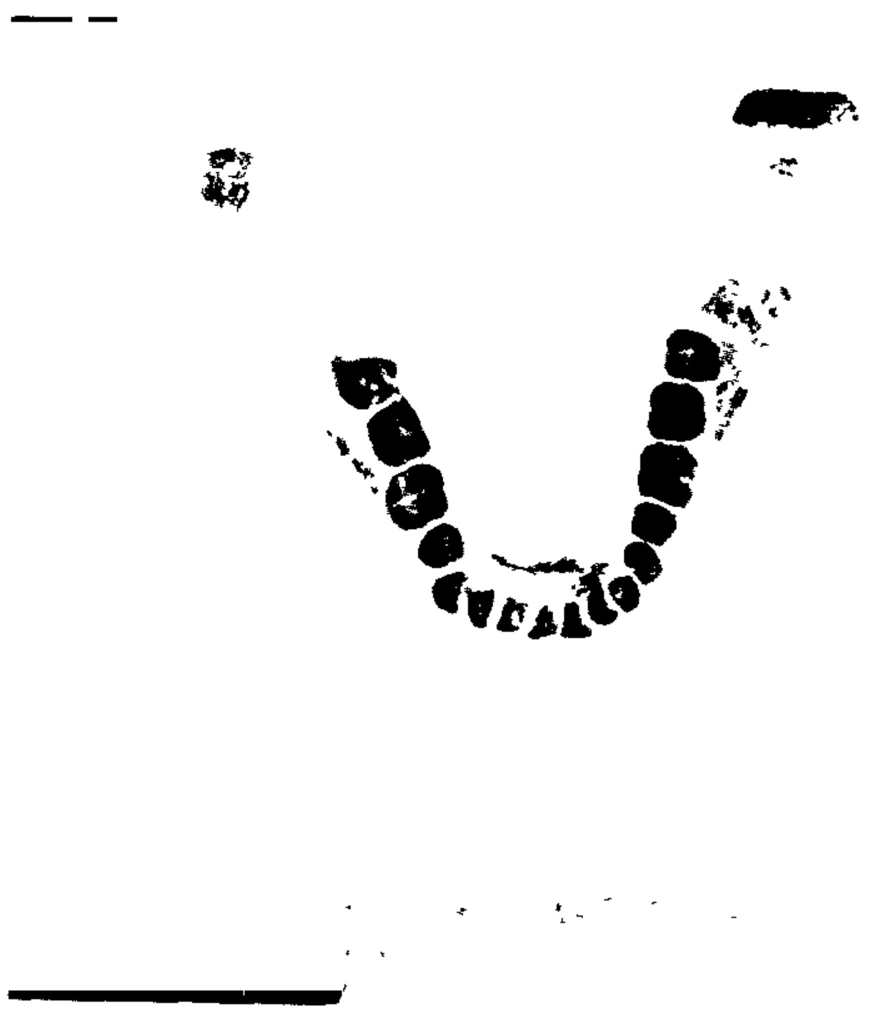
E

A, *Vertical view of mandible of skl. no. 7* ; B, *Side view of mandible of skl. no. 7* ; C, *Norma verticalis of skl. no. 8* ; D, *Norma lateralis of skl. no. 8* ; E, *Norma facialis of skl. no. 8* *See pp. 276 and 277*

PLATE CXXXV

A

B



C

D

A, *Norma occipitalis of skl. no.* 8 ; B, *Norma basalis of skl. no.* 8 ; C, *Vertical view of mandible of skl. no.* 8 ; D, *Side view of mandible of skl. no.* 8. *See p.* 277

PLATE CXXXVI

A

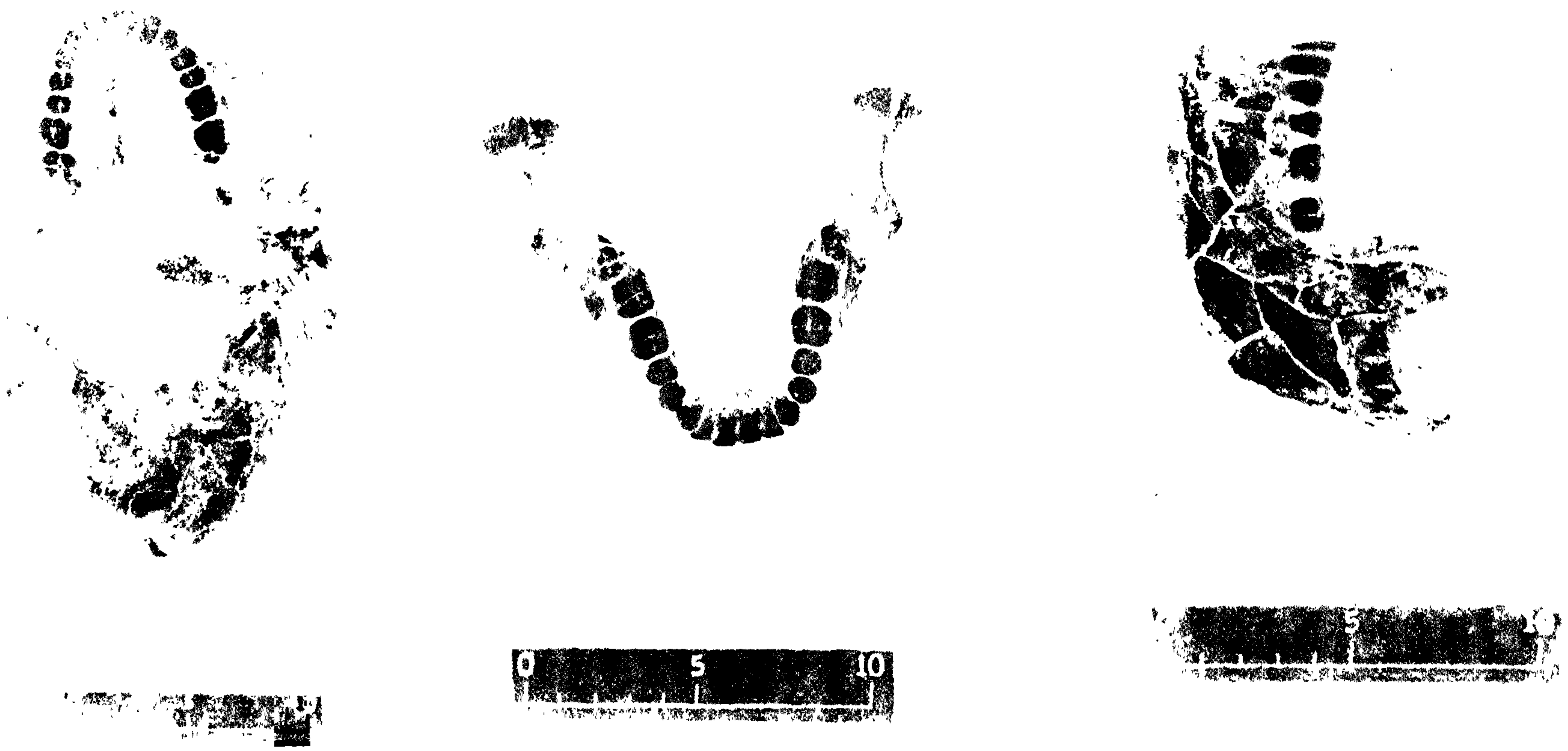
B

C

D

A, *Norma verticalis of skl. no.* 9 ; B, *Norma lateralis of skl. no.* 9 ; C, *Norma facialis of skl. no.* 9 ; D, *Norma occipitalis of skl. no.* 9. *See p. 278*

PLATE CXXXVII



A B C

A, *Norma basalis of skl. no.* 9 ; B, *Vertical view of mandible of skl. no.* 9 ; C, *Side view of mandible of skl. no.* 9. *See p. 278*

PLATE CXXXVIII

A

B

C

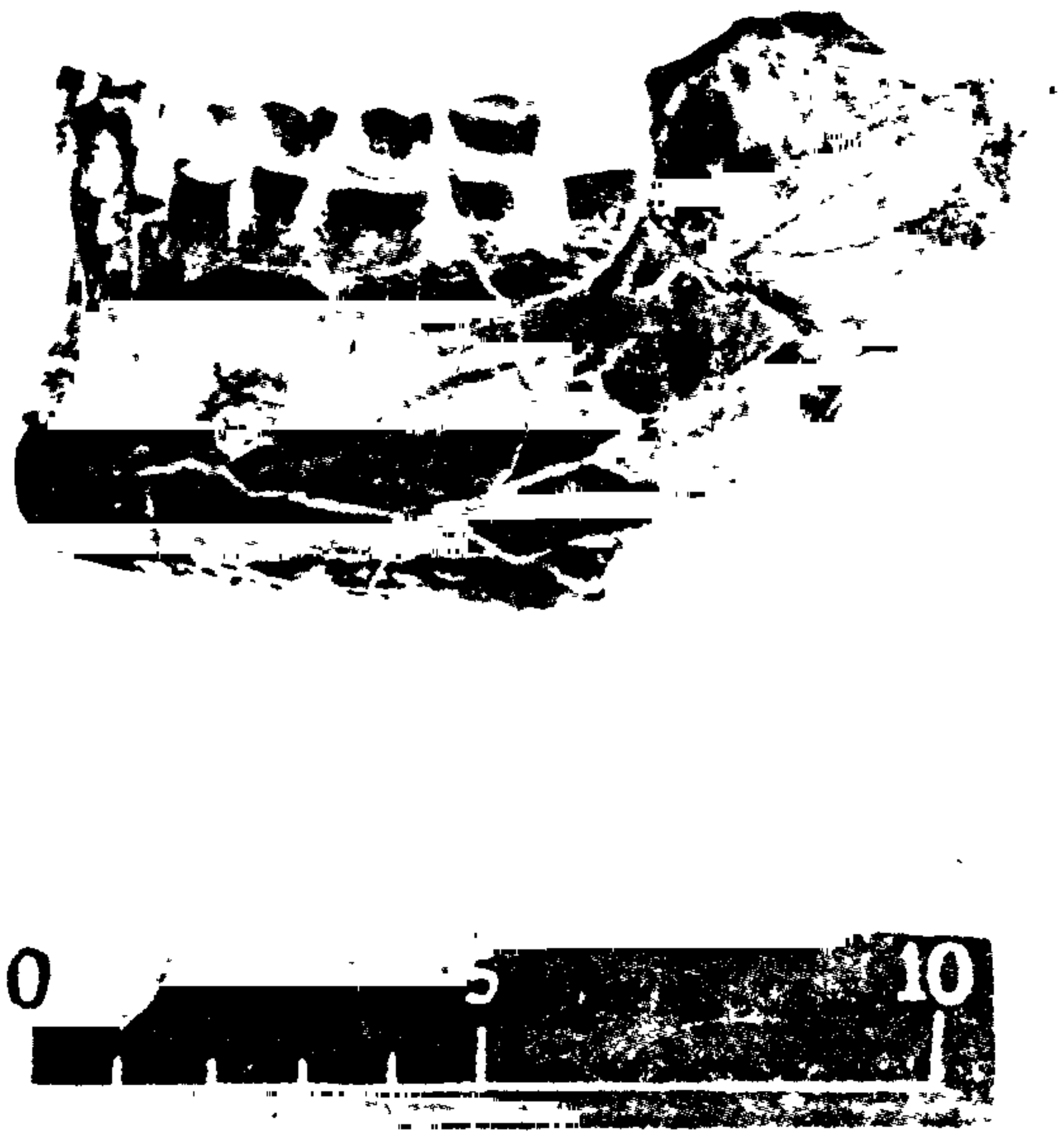
D

A, *Norma verticalis of skl. no.* 10 ; B, *Norma lateralis of skl. no.* 10 ; C, *Norma facialis of skl. no.* 10 ; D, *Norma occipitalis of skl. no.* 10. *See p. 278*

PLATE CXXXIX

A

B

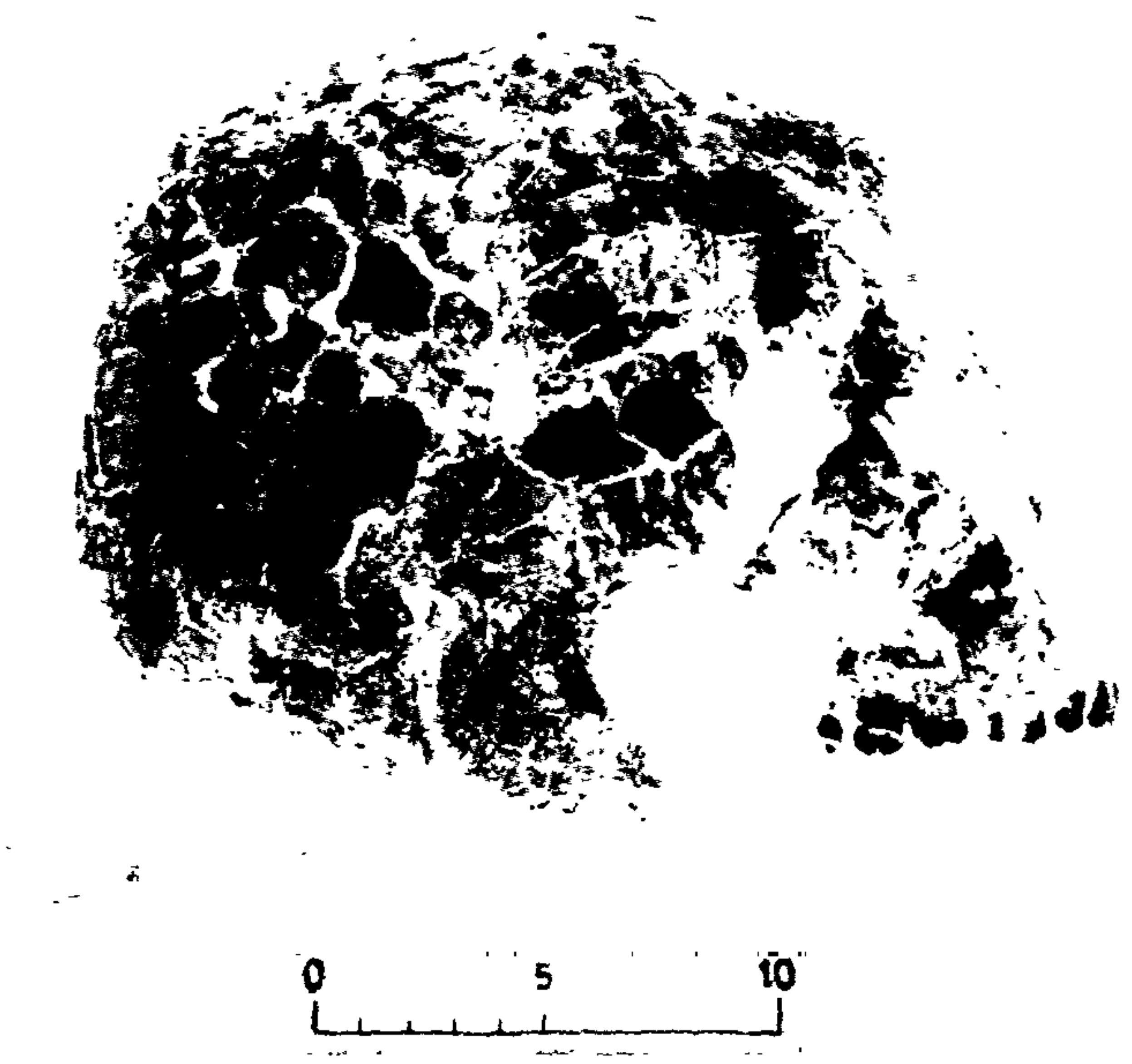


C

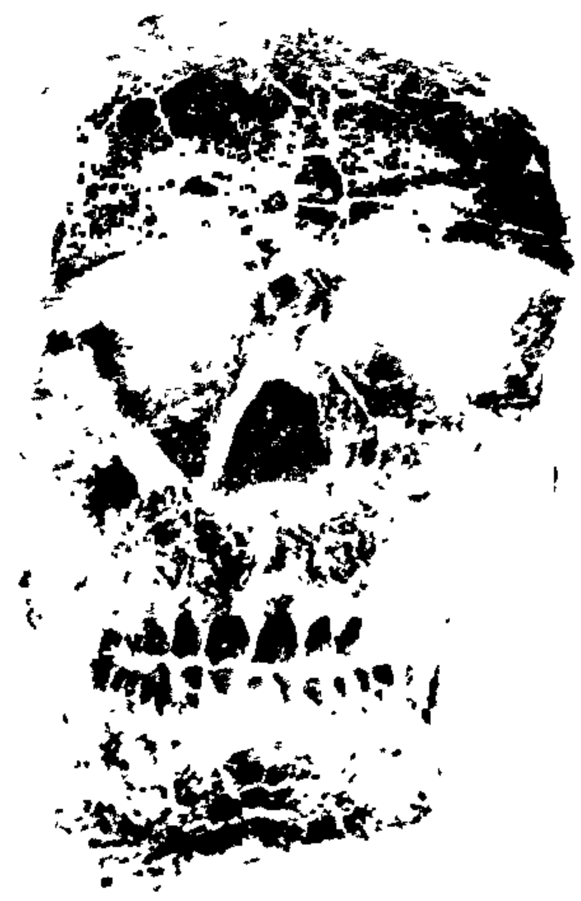
A, *Norma basalis of skl. no. 10*; B, *Vertical view of mandible of skl. no. 10*; C, *Side view of mandible of skl. no. 10*. *See p. 278*

PLATE CXL

A



B



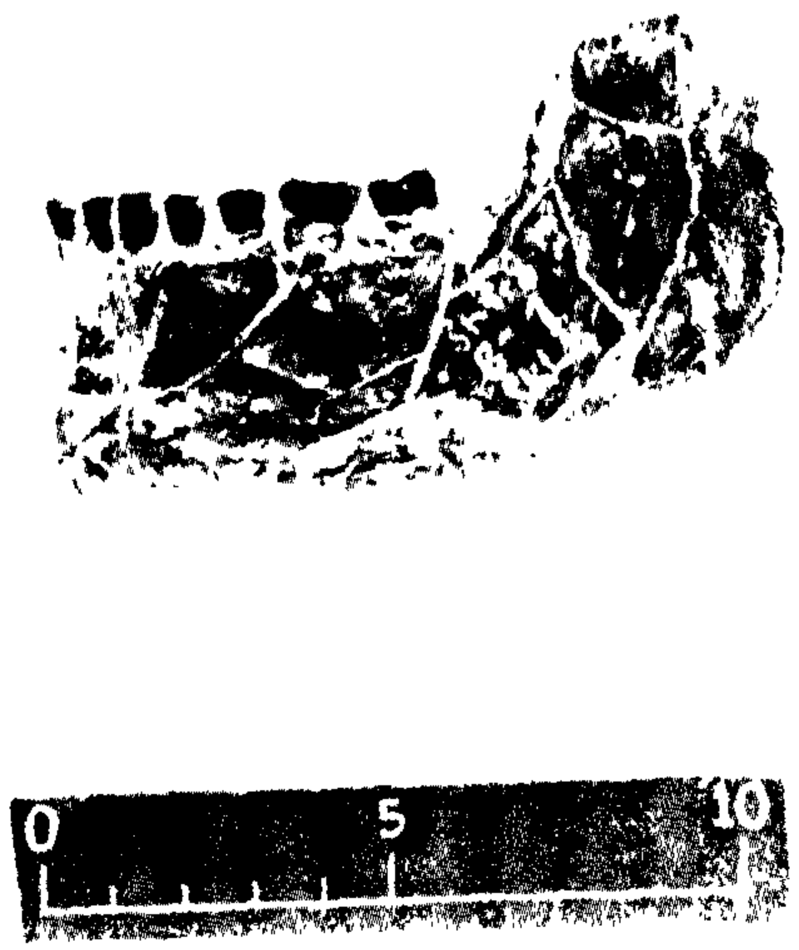
C

D

A, *Norma verticalis of skl. no. 11* ; B, *Norma lat·ralis of skl. no. 11* ; C, *Norma facialis of skl. no. 11* ; D, *Norma occipitalis of skl. no. 11*. *See pp. 279 and 280*

A

B

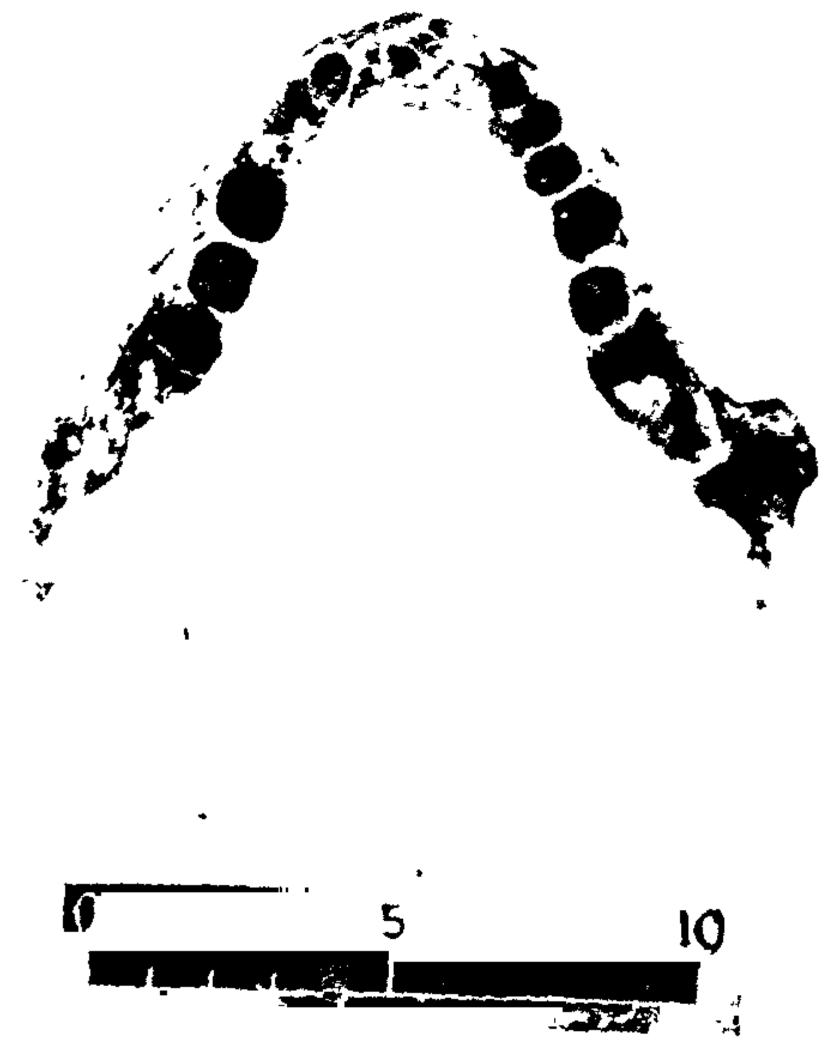


C

A, *Norma basalis of skl. no. 11* ; B, *Vertical view of mandible of skl. no. 11* ; C, *Side view of mandible of skl. no. 11.* *See p. 279*

A

B

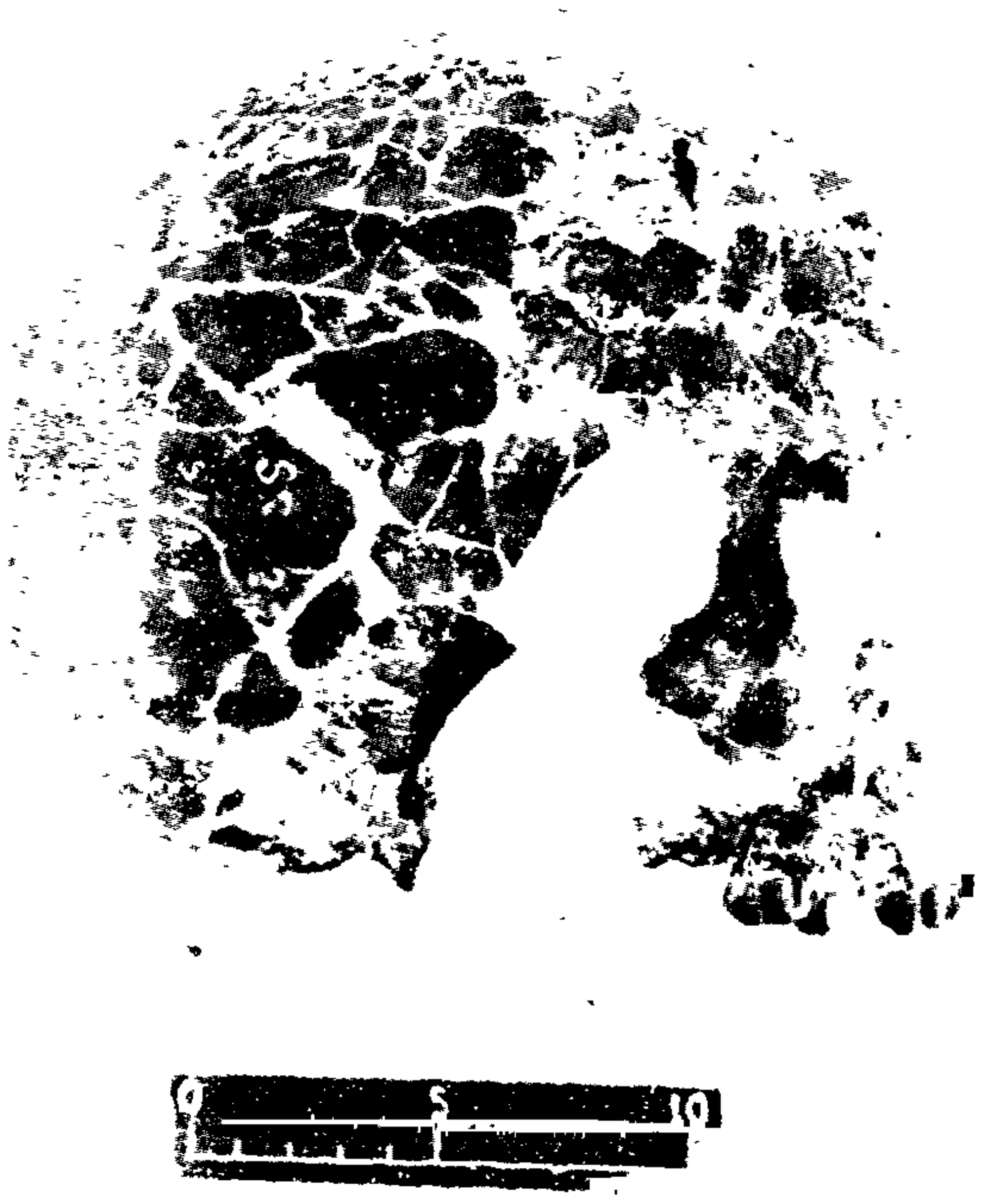


C

D

A, *Norma facialis of skl. no. 13* ; B, *Norma basalis of skl. no. 13* ; C, *Vertical view of mandible of skl. no. 13* ; D, *Side view of mandible of skl. no. 13. See p. 280*

A



B

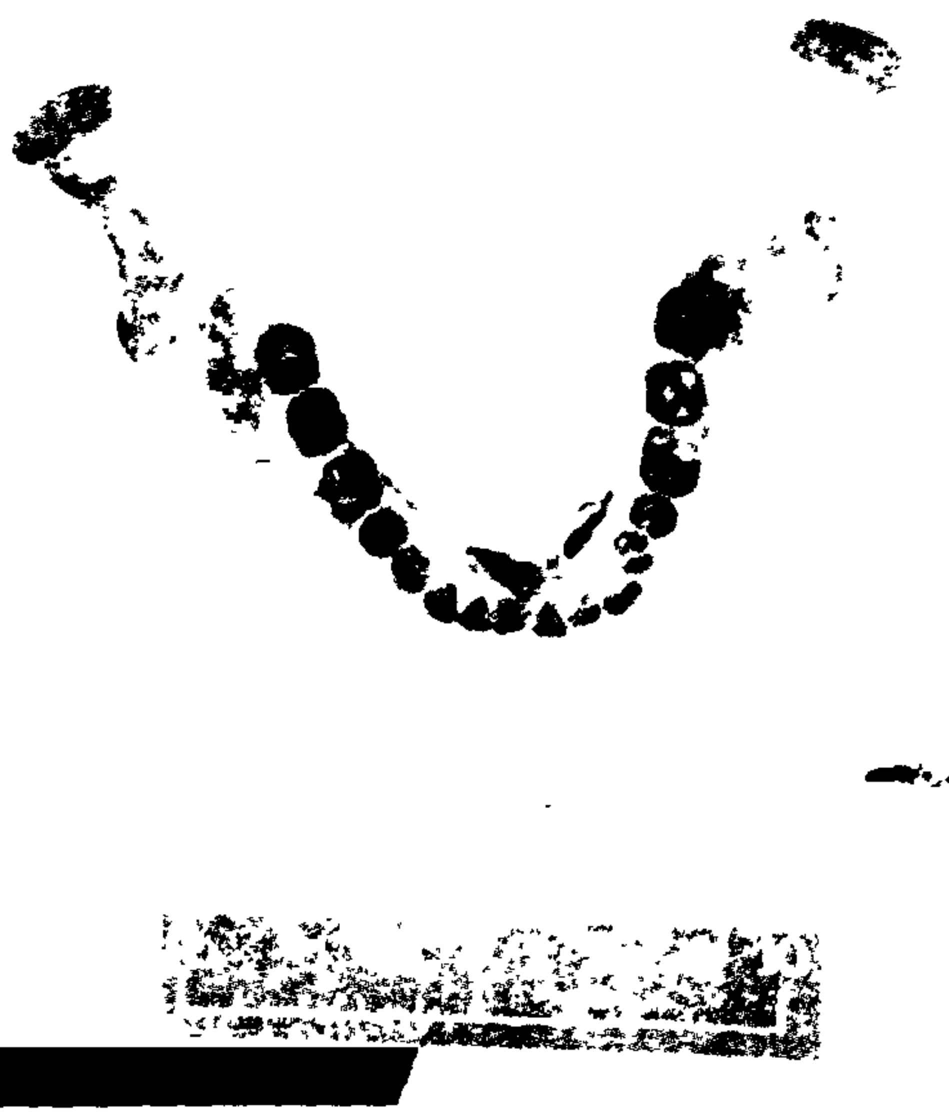
C

D

A, *Norma verticalis of skl. no. 14* ; B, *Norma lateralis of skl. no. 14* ; C, *Norma facialis of skl. 14* ; D, *Norma occipitalis of skl. no. 14.* *See p. 281*

PLATE CXLIV

A

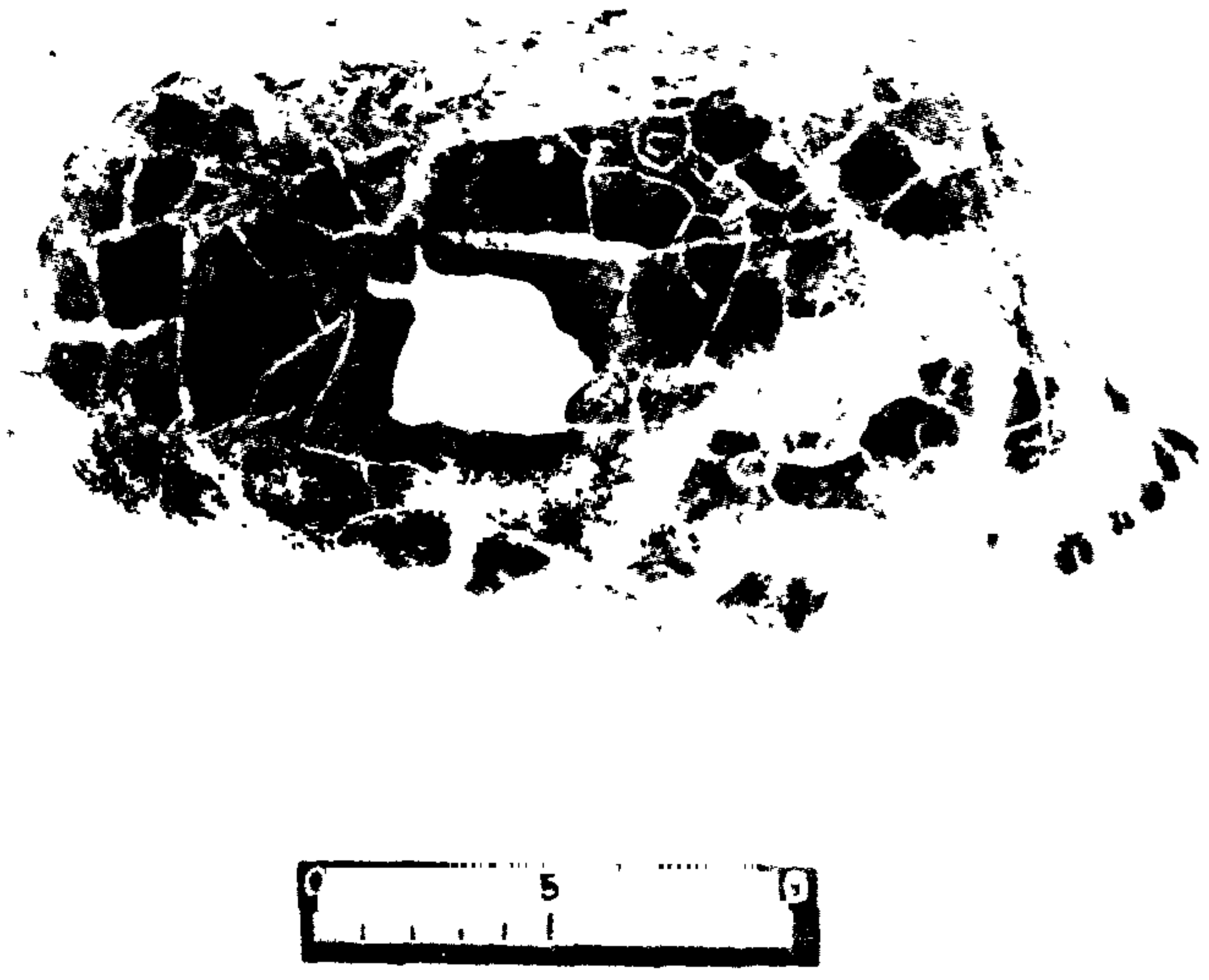


A, *Norma basalis of skl. no. 14* ; B, *Vertical view of mandible of skl. no. 14* ;
C, *Side view of mandible of skl. no. 14.* *See p. 281*

PLATE CXLV

A

B



C

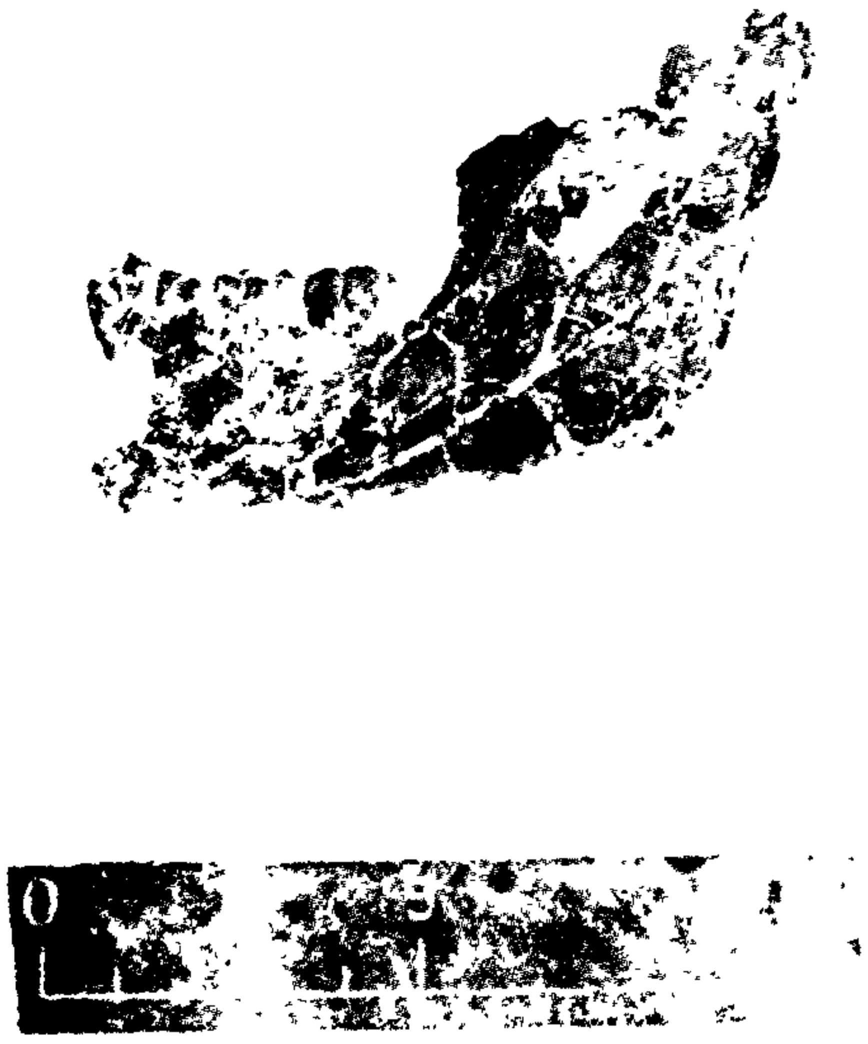
D

A, *Norma verticalis of skl. no. 15* ; B, *Norma lateralis of skl. no. 15*; C, *Norma facialis of skl. no. 15* ; D, *Norma occipitalis of skl no. 15*. *See p. 282*

PLATE CXLVI

A

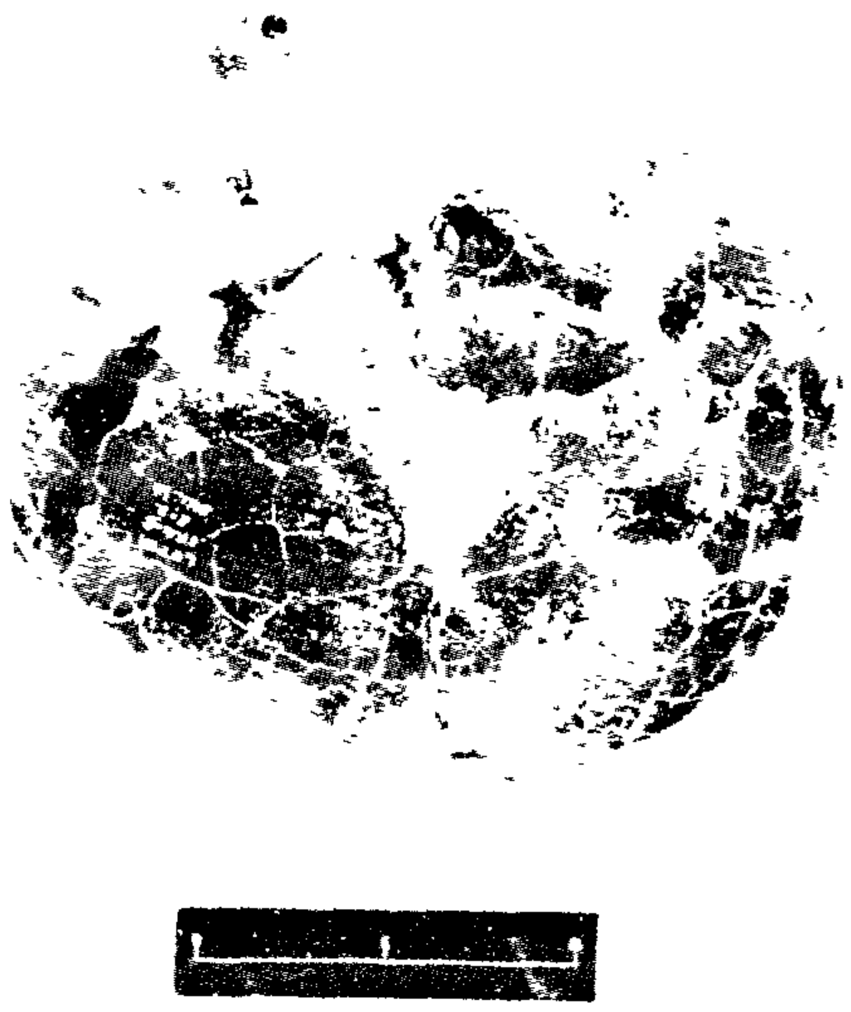
B



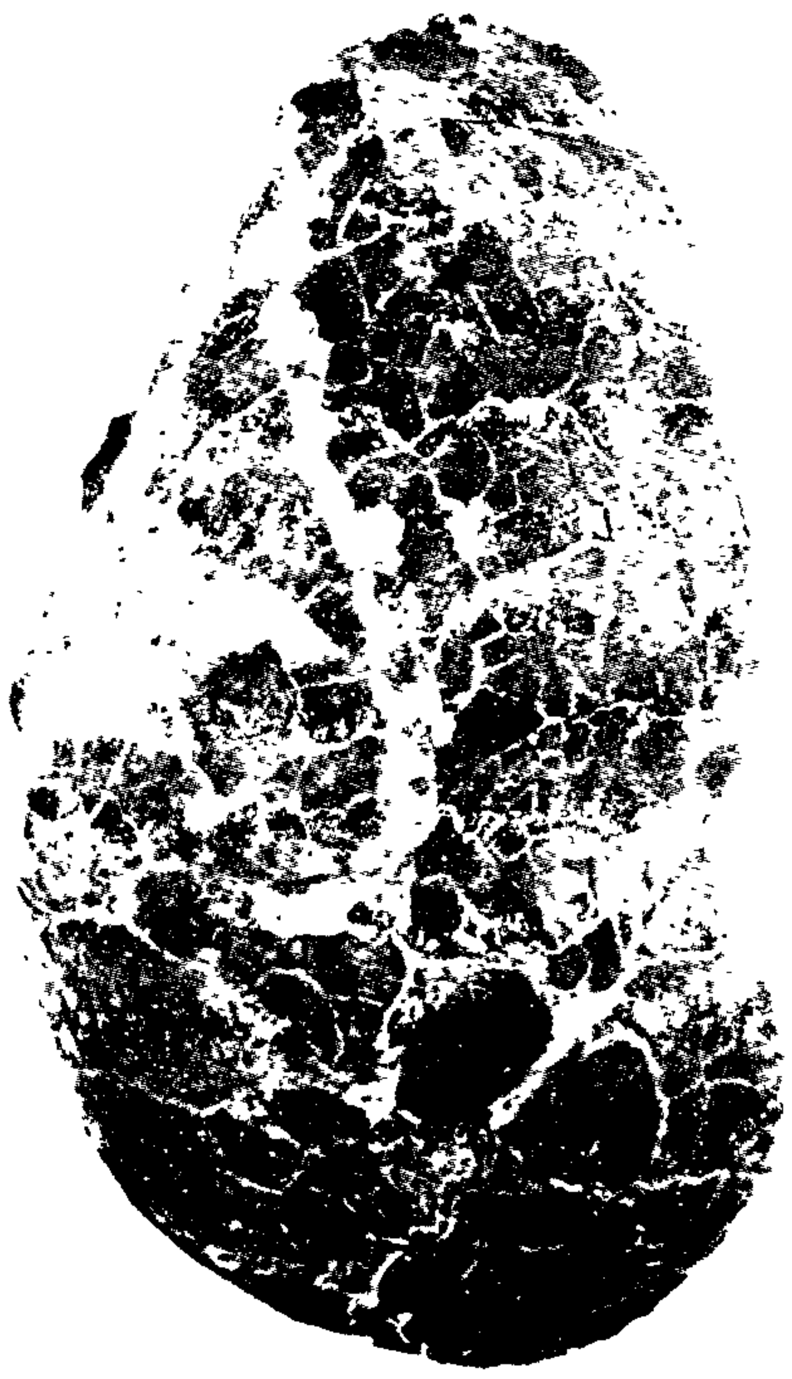
C

A, *Norma basalis of skl. 15*; B, *Vertical view of mandible of skl. no. 15*; C, *Side view of mandible of skl. no. 15*. *See p. 282*

PLATE CXLVII



A

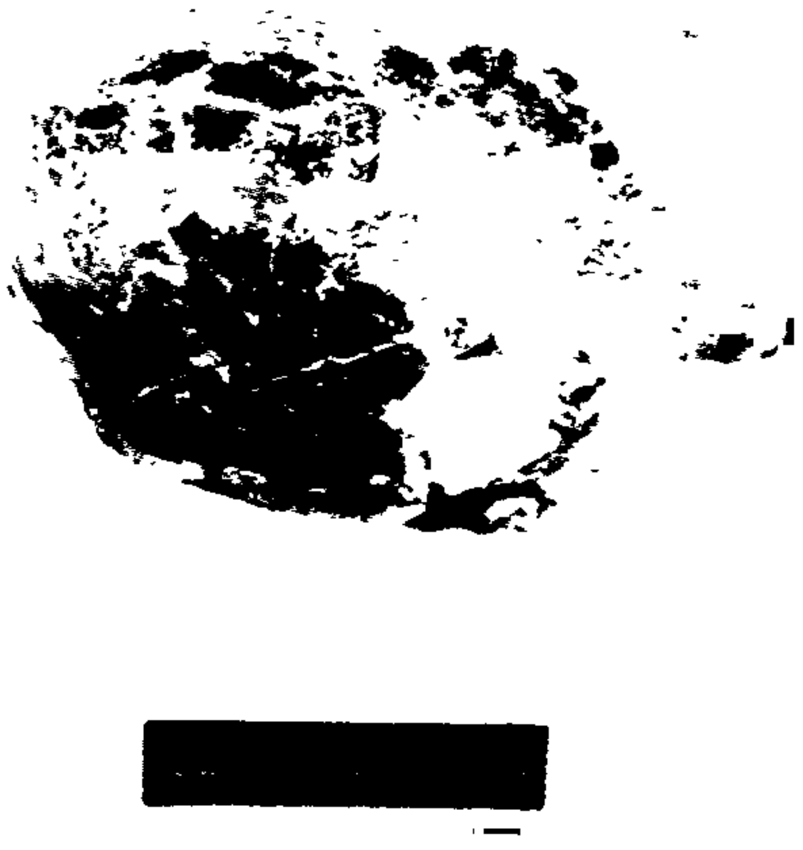


B

A, *Norma facialis of skl. no. 16* ; B, *Norma lateralis of skl. no. 16.* *See p. 284*

A

B



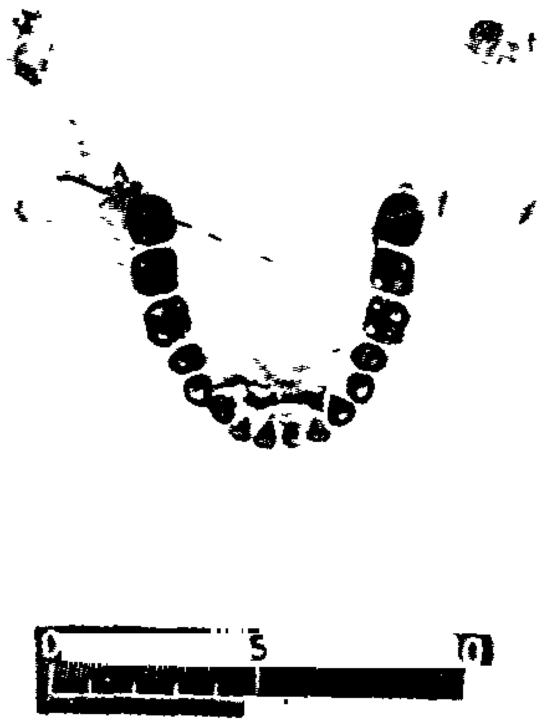
C

D

E

A, *Norma verticalis of skl. no. 17* ; B, *Norma lateralis of skl. no. 17* ; C, *Norma facialis of skl. no. 17* ; D, *Norma occipitalis of skl. no. 17* ; E, *Norma basalis of skl. no.* 17. *See p. 284*

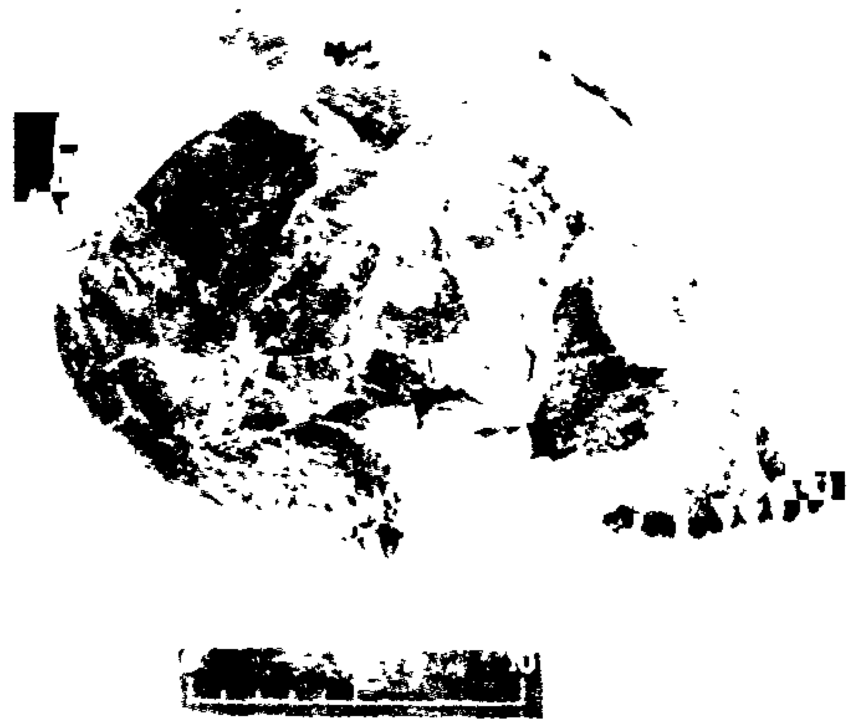
PLATE CXLIX



A

B

C



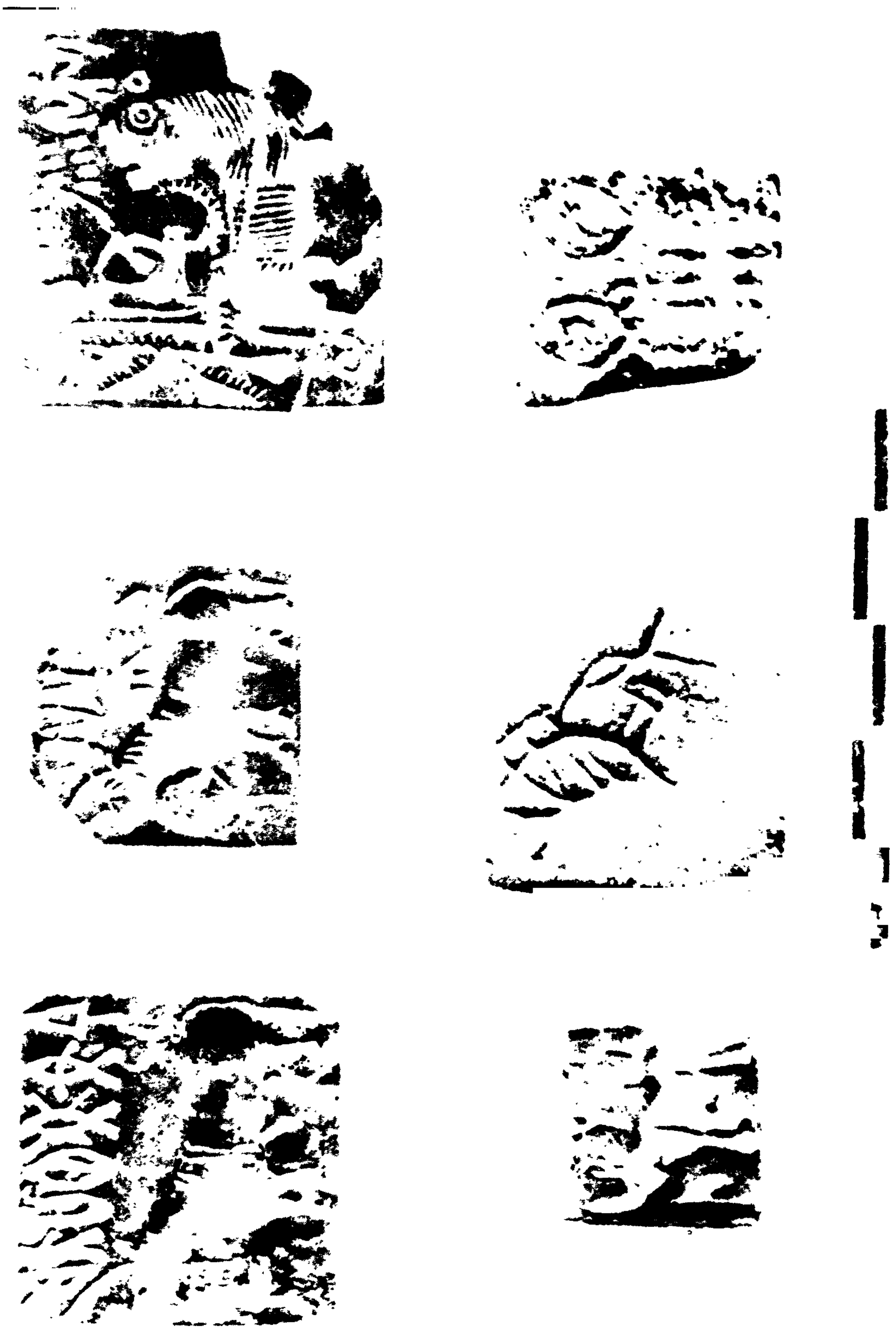
D

E

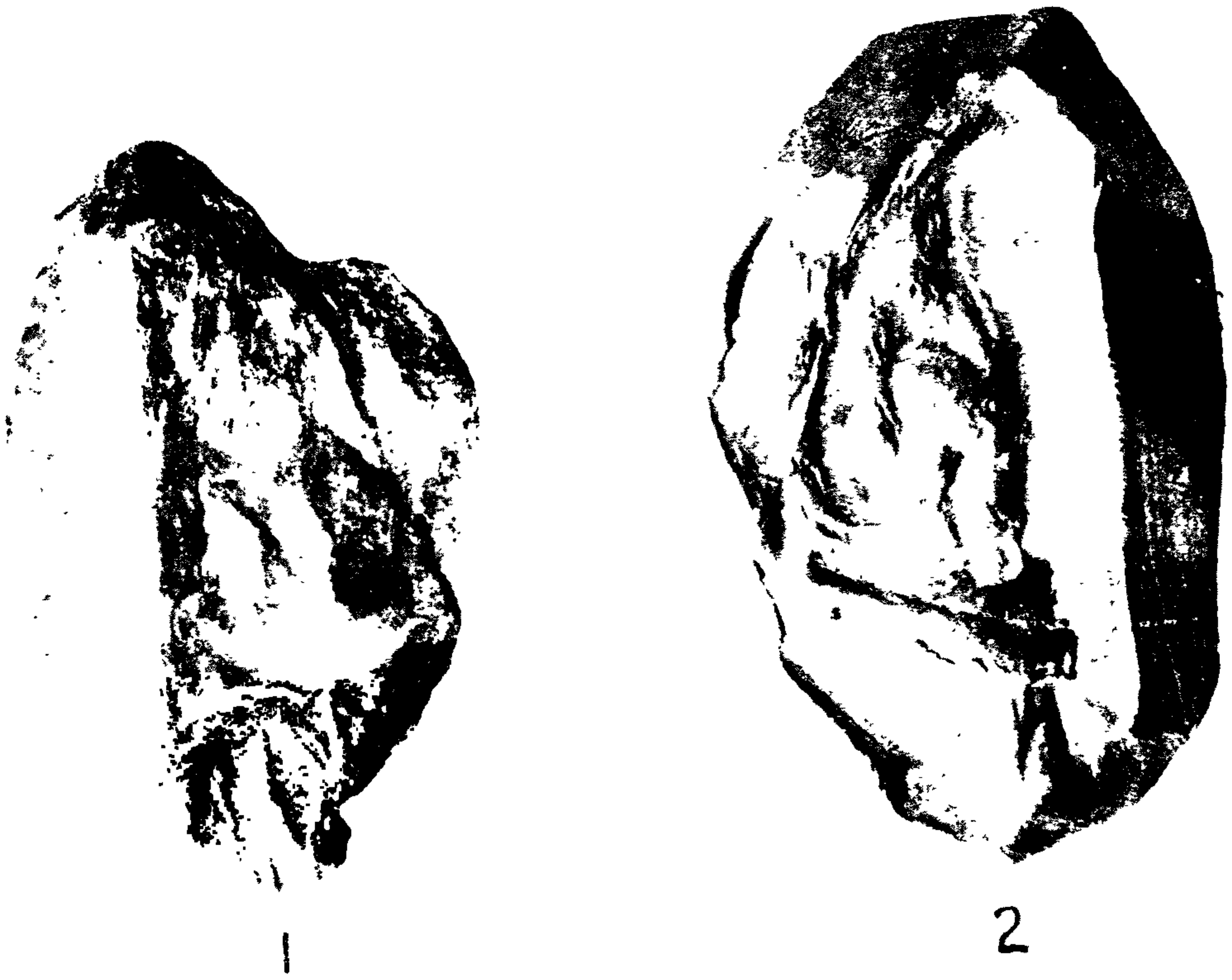
F

G

A, *Vertical view of mandible of skl. no. 17*; B, *Side view of mandible of skl. no. 17*; C, *Norma verticalis of skl. no. 18*; D, *Norma lateralis of skl. no. 18*; E, *Norma facialis of skl. no. 18*; F, *Norma occipitalis of skl. no. 18*; G, *Norma basalis of skl. no. 18*. *See pp. 284 and 285*



Seals from Kalibangan. *See p.* 302



A

B

A, *Terracotta sealing bearing impressions of twisted cords tied into a knot, 1 original, 2 impressions* ; B, *baked sealings from Lothal. See p. 305*

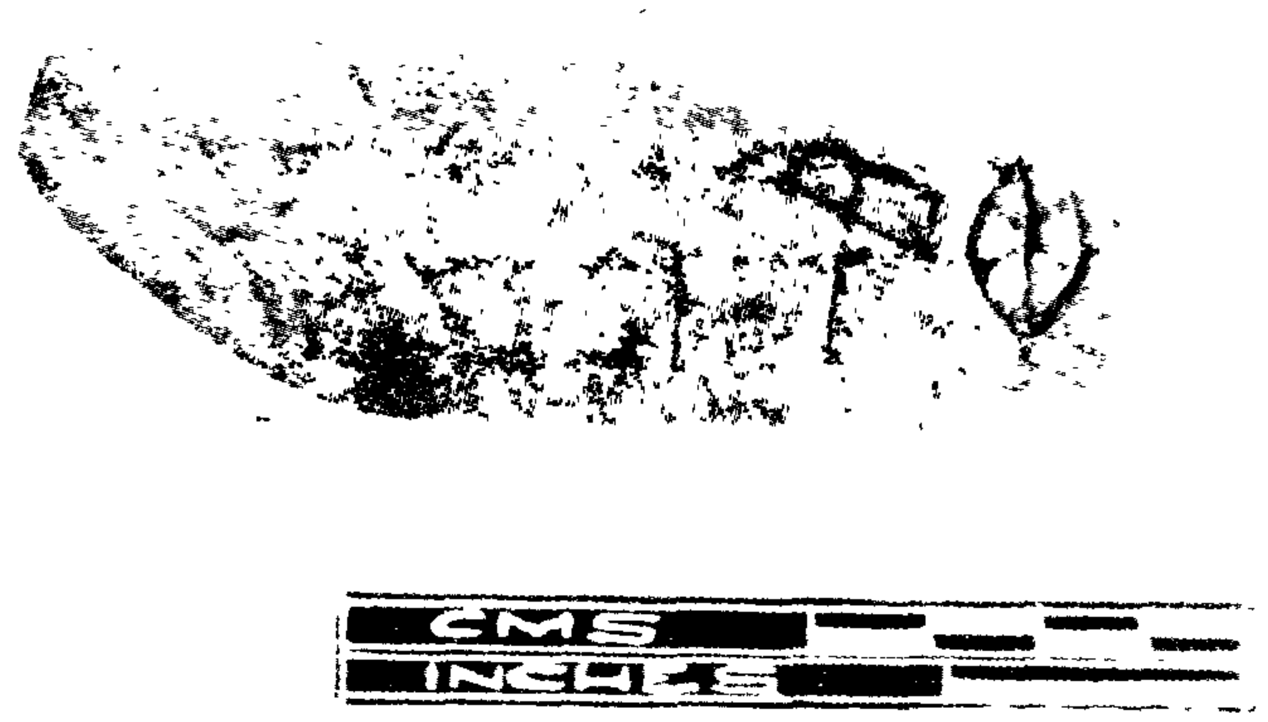
A

B

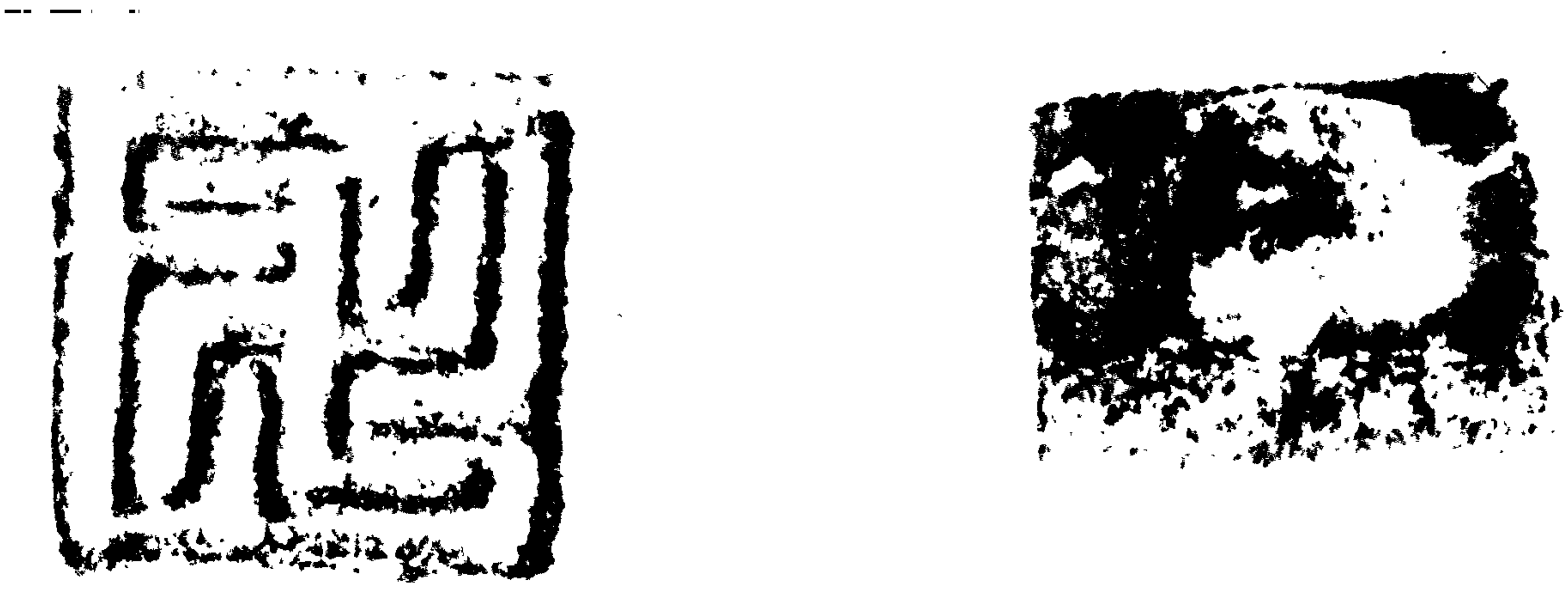
C

A, *Steatite block for making a seal, Scale 2/1* ; B, *Partially-engraved seal with an unfinished boss on the back, Scale 1/1* ; C, *Worn-out seal thinned for recutting.* *See pp. 306 and 307*

A

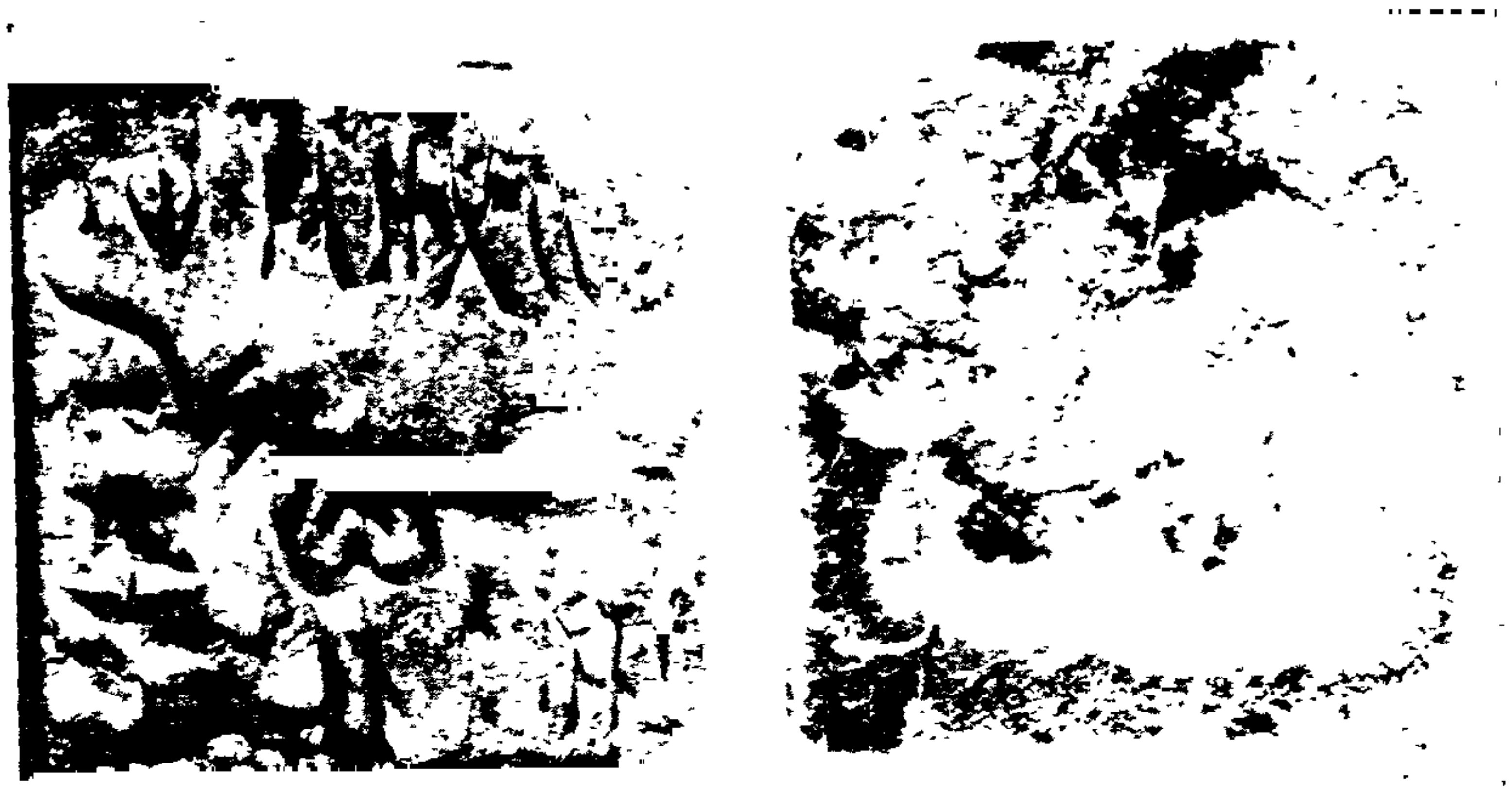


B

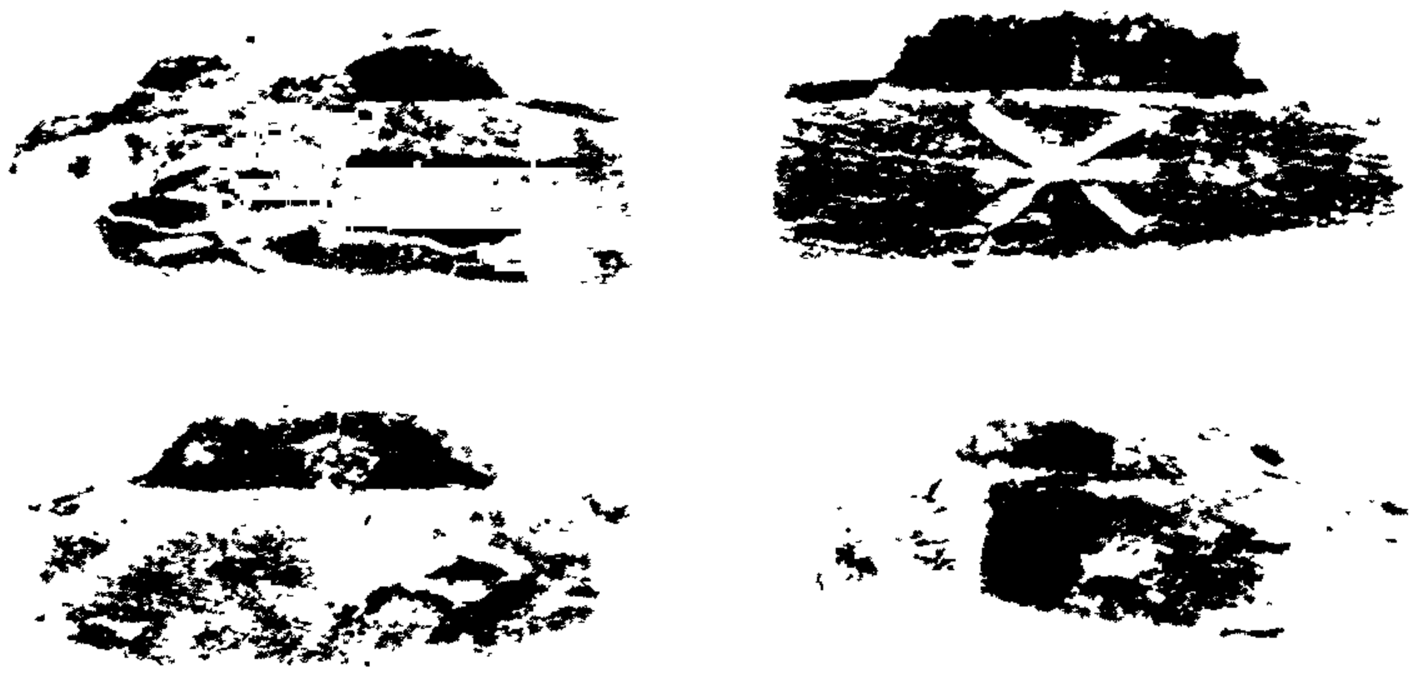


C

A, *Steatite seal with a segmented boss on the back. Scale 1:1*; B, *Steatite seal with Indus script written from right to left*; C, *Steatite seal with a swastika symbol. Scale 1:2.* *See pp. 307, 313 and 314*



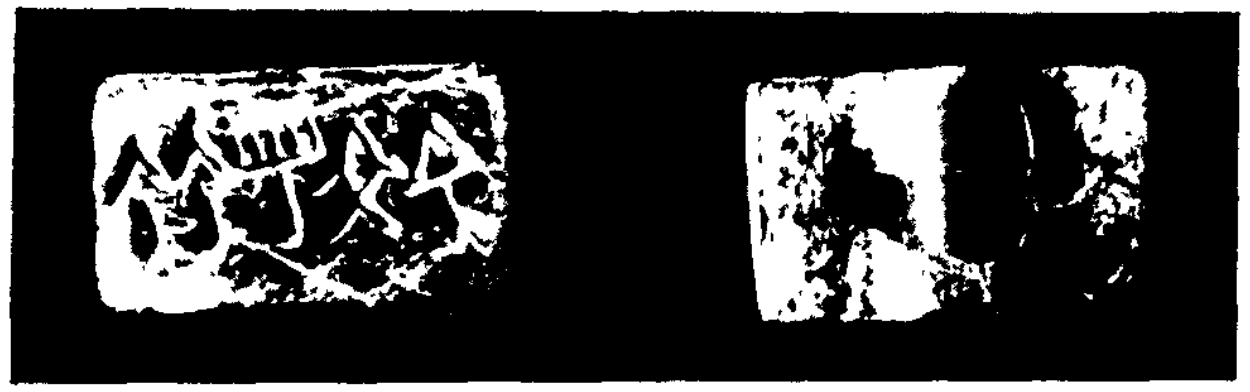
A



B

C

A, Unique steatite seal with Indus script engraved on the front and sides. Front and back view. Scale 1/1; B, Above mentioned seal with Indus signs engraved on four sides; C, Copper seal with Indus script and unicorn on the front and loop ring on the back, Scale 1:1. *See p. 314*



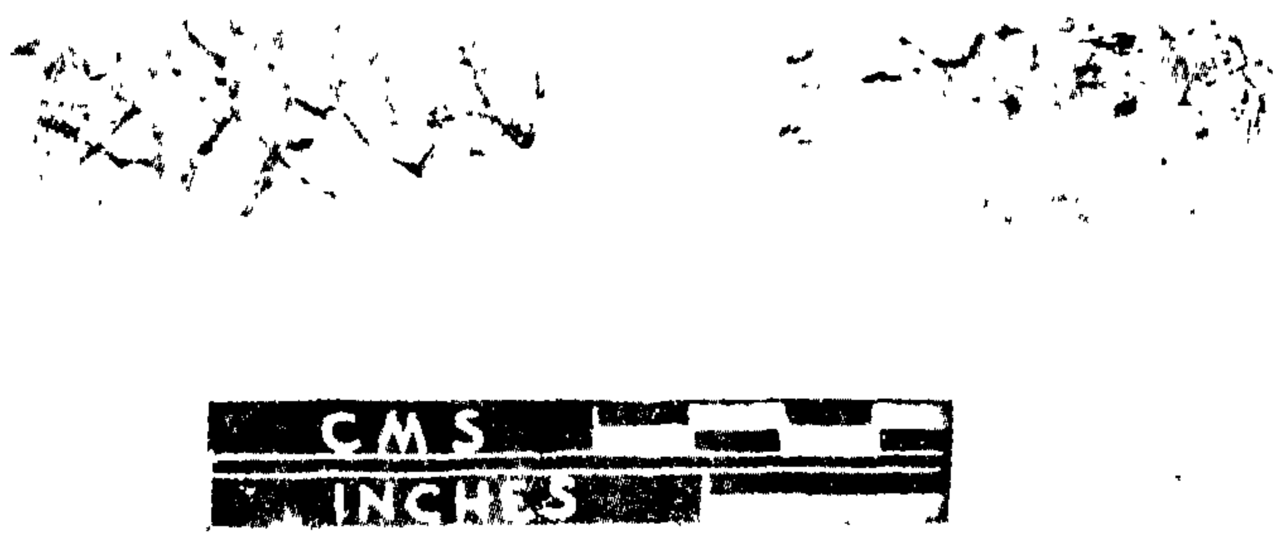
A

B

2

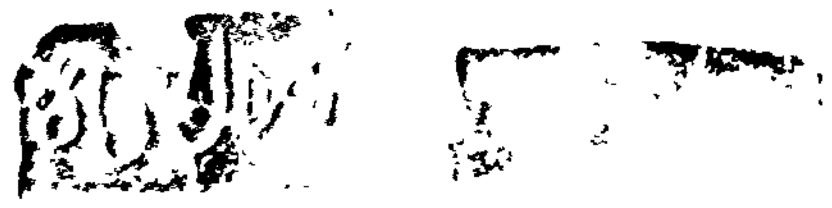
1

C

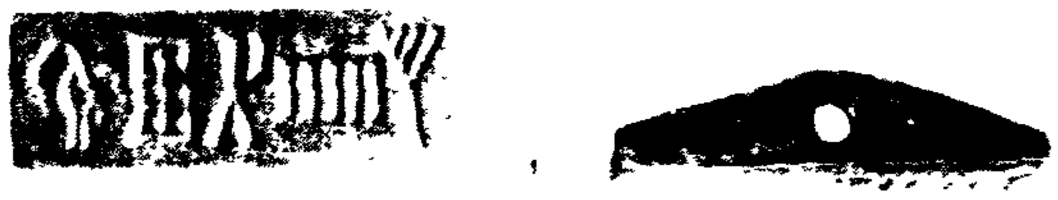


D

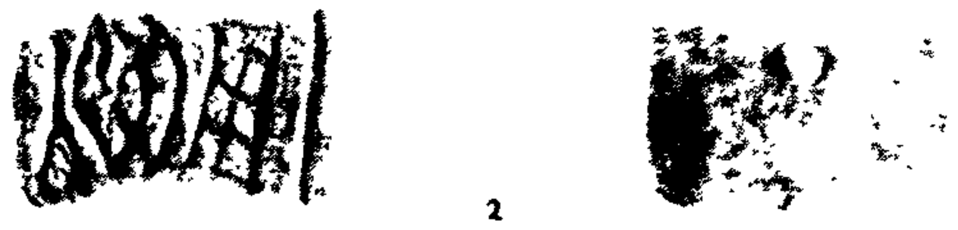
A, *Soapstone seal with Indus script and perforated boss, Scale 1/1* ; B, *Steatite seal from Period B with linear Indus signs, Scale 1/1* ; C, *Agate seal with Indus signs, but no boss* ; D, *Terracotta seals with Indus script.* 1 *Unperforated*, 2 *perforated axially, Scale 1/1.* *See pp. 307 and 314*



A



1



2

B

1

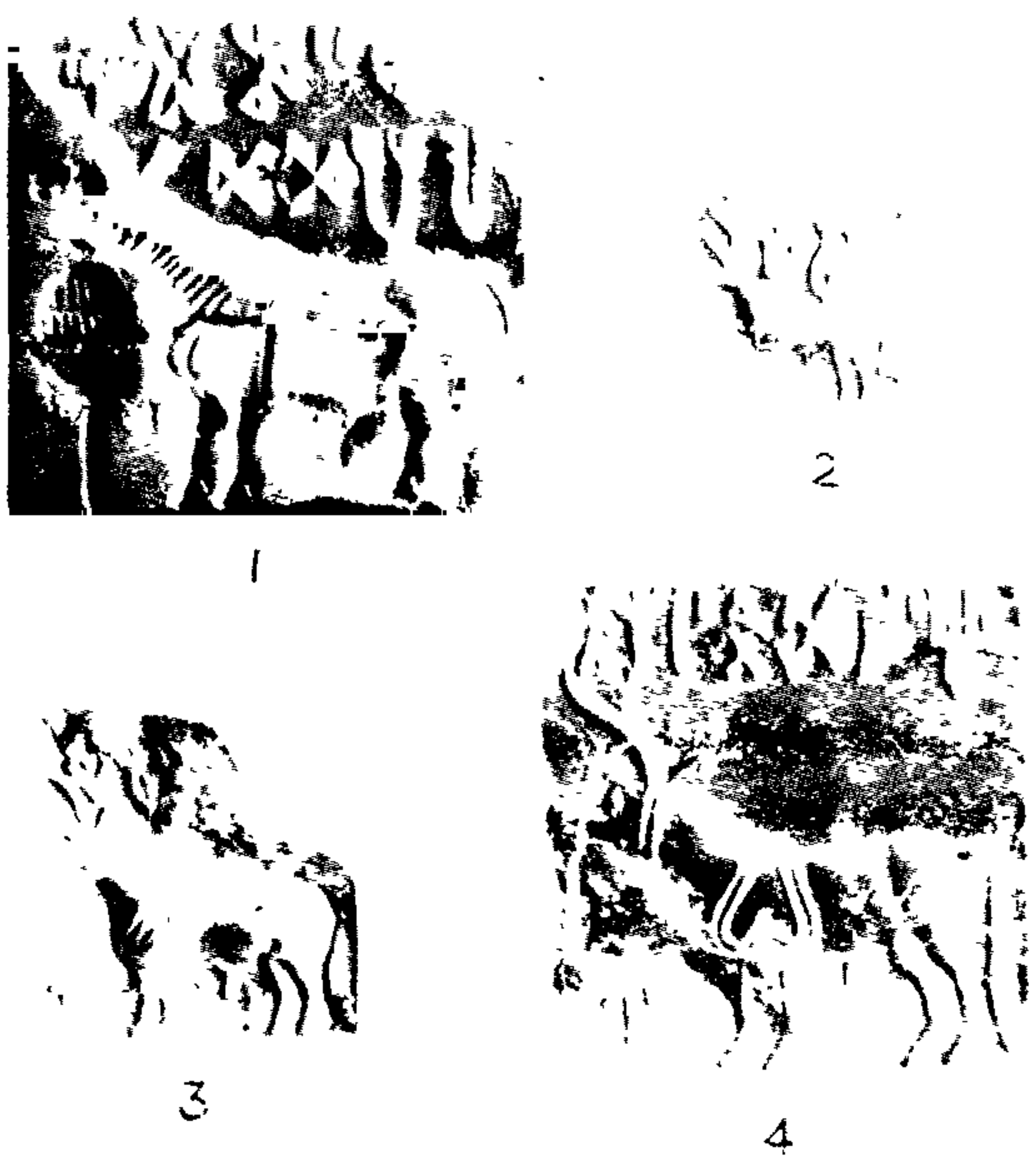
2

3

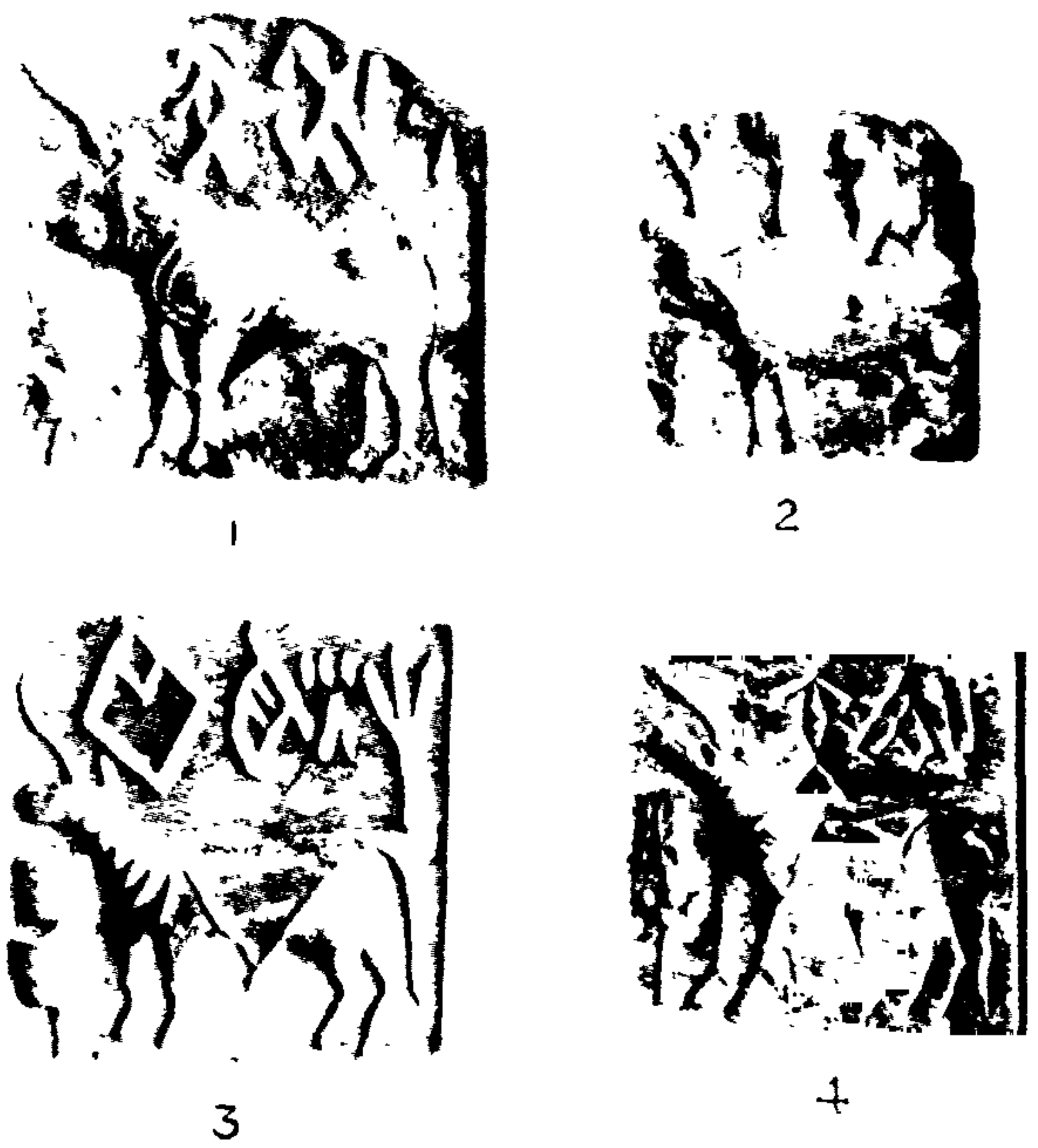
4

C

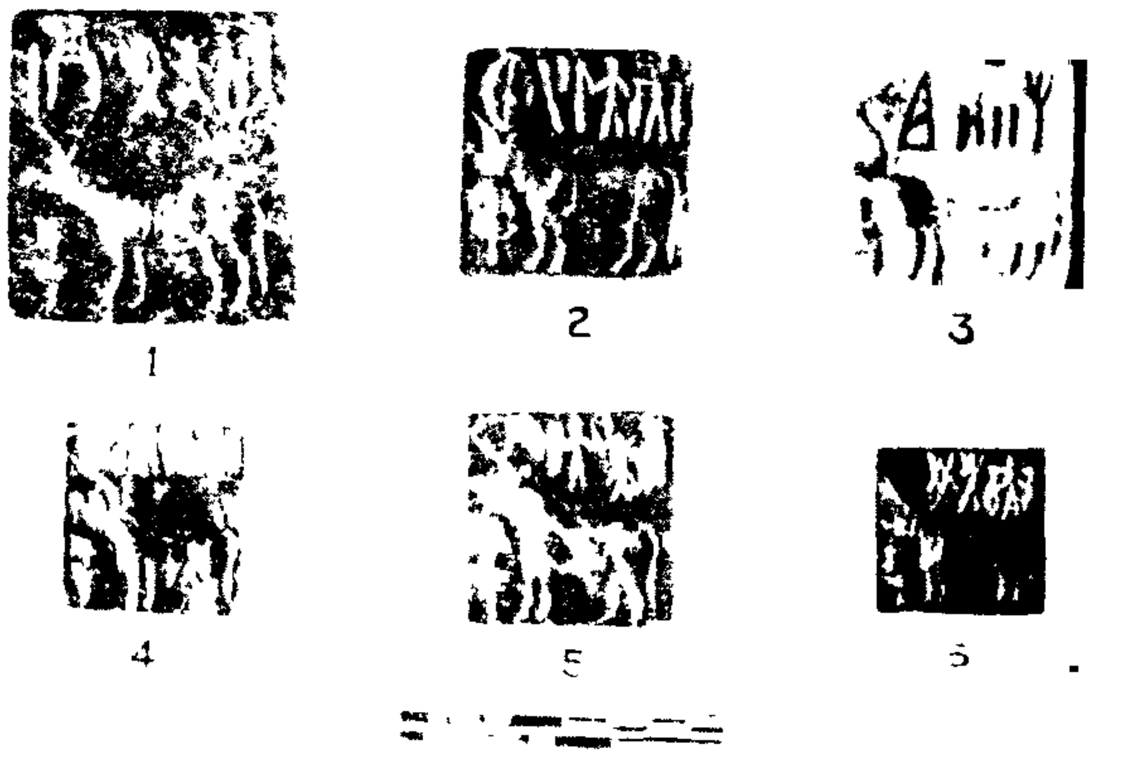
A, *Terracotta seal with Indus script and a transverse hole, Scale 1:1*; B, *1 steatite seal with a triangular section and Indus script, 2 terracotta seal with a planoconvex section and Indus script, Scale 1:1*; C, *Rectangular steatite seals with Indus script and unicorn. Scale 1:1.* *See pp. 314 and 315*



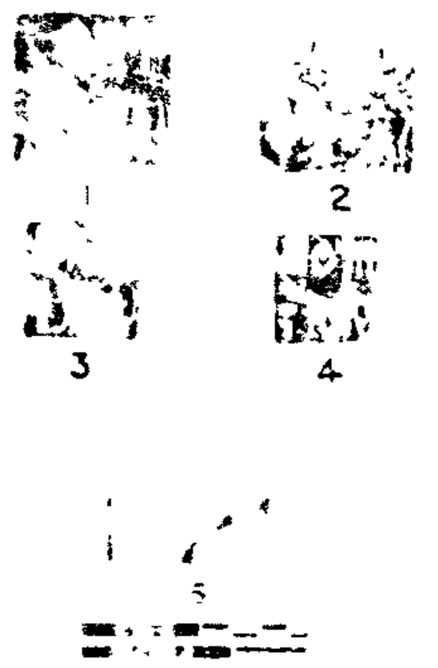
A



B



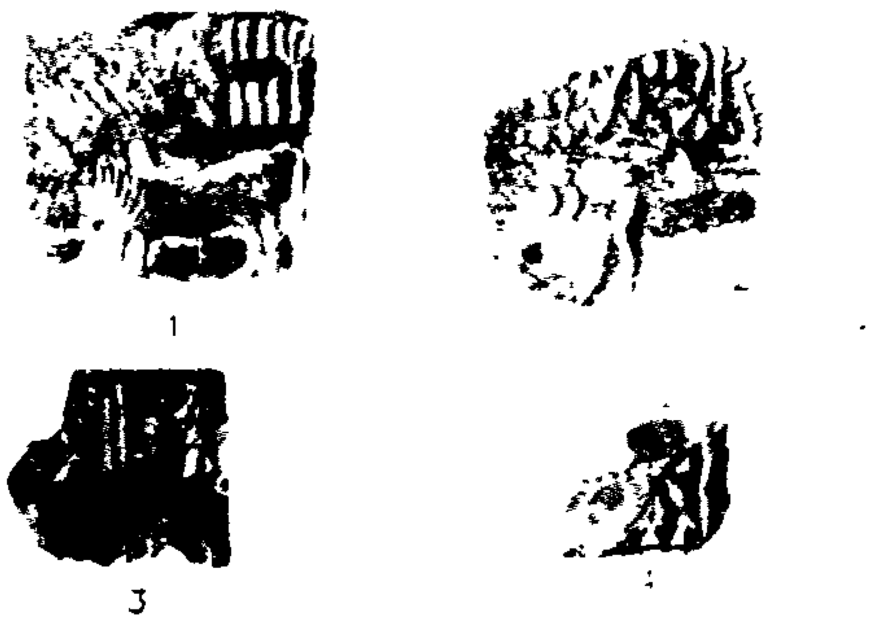
C



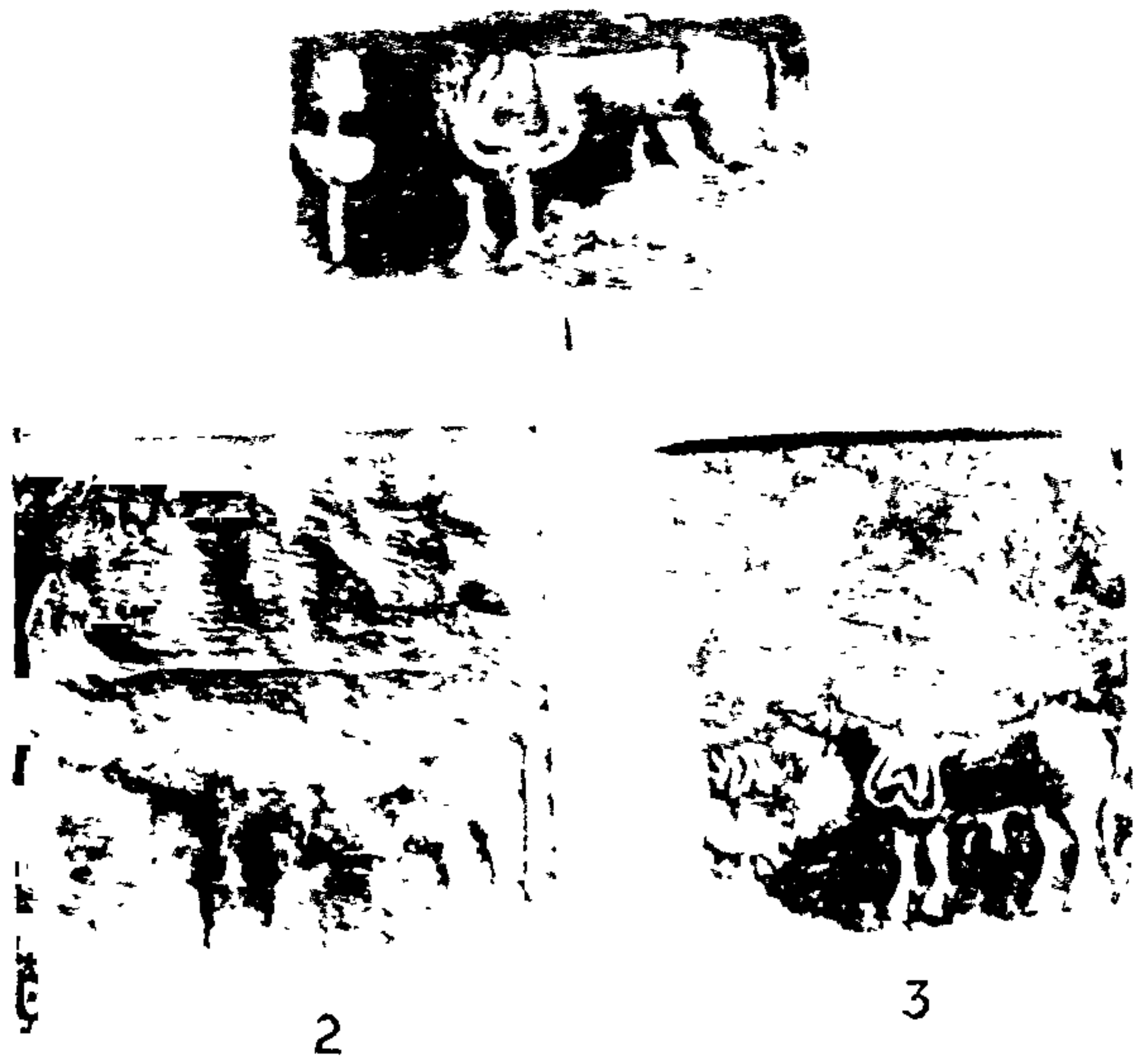
D

A, *Steatite seals with Indus script and unicorn*, *Scale* 1/1; B, *Soapstone seals with Indus script and unicorn. Scale* 1/1; C, *Steatite seals with Indus script and unicorn*; D, *Seals with Indus script and unicorn*, 1-4 *steatite*, 5 *soapstone*. *See p. 315*

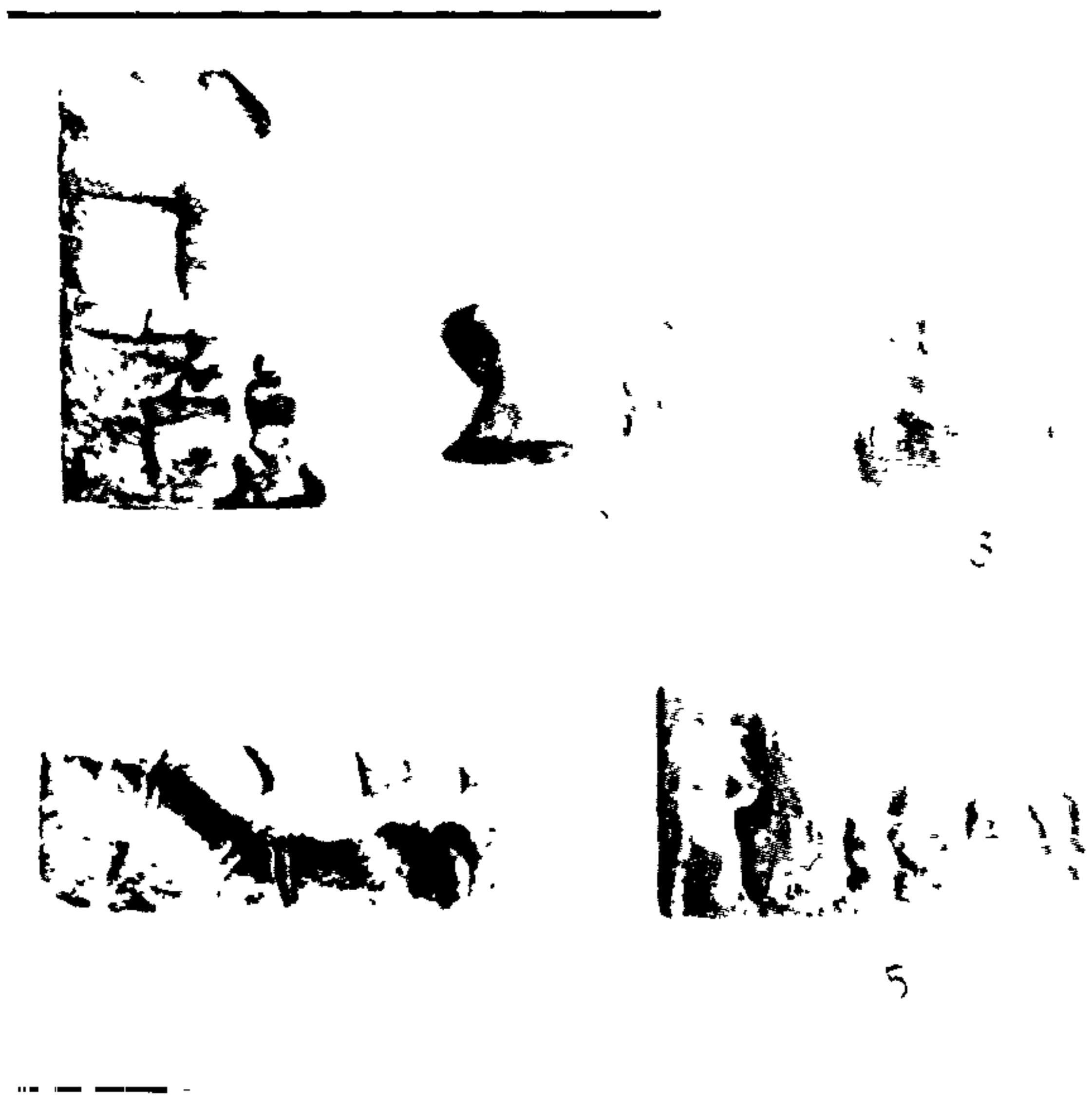
A



B

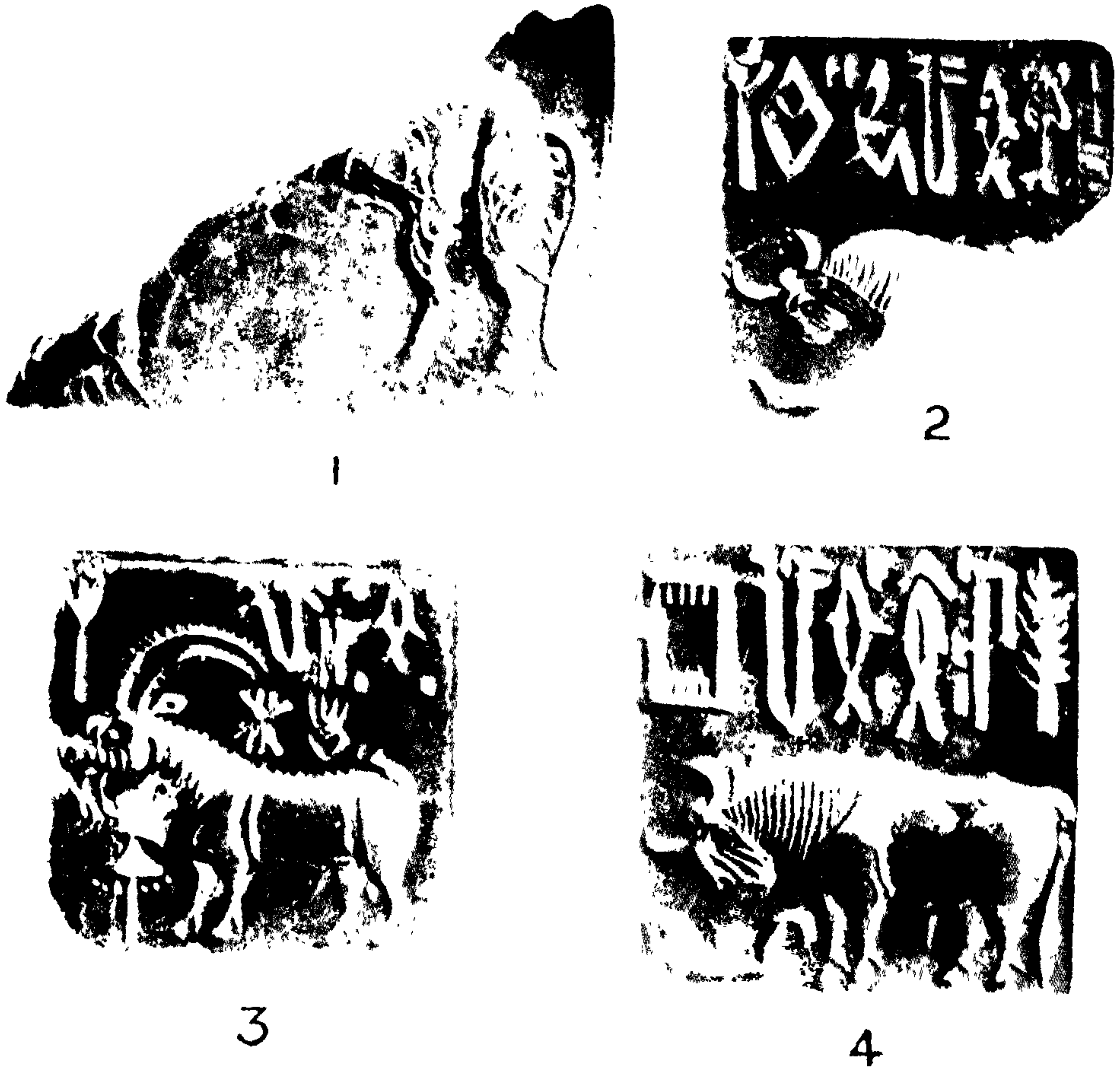


C



D

A, *Steatite seal with Indus script and unicorn. Scale* 1/1; B, *Seals with Indus script and unicorn partially visible*, 1-2 *soapstone*, 3-4 *steatite. Scale* 1:1; C, *Seals with unicorn. Script damaged in no.* 2 *Upper part of no* 3 *sawn off for re-engraving*, 1-3 *steatite*, 2 *ivory. Scale* 1:1; D, *Seals with unicorn. Script portion missing*, 1-3 *and* 5 *steatite*, 4 *soapstone. Scale* 1:1 *See p. 316*

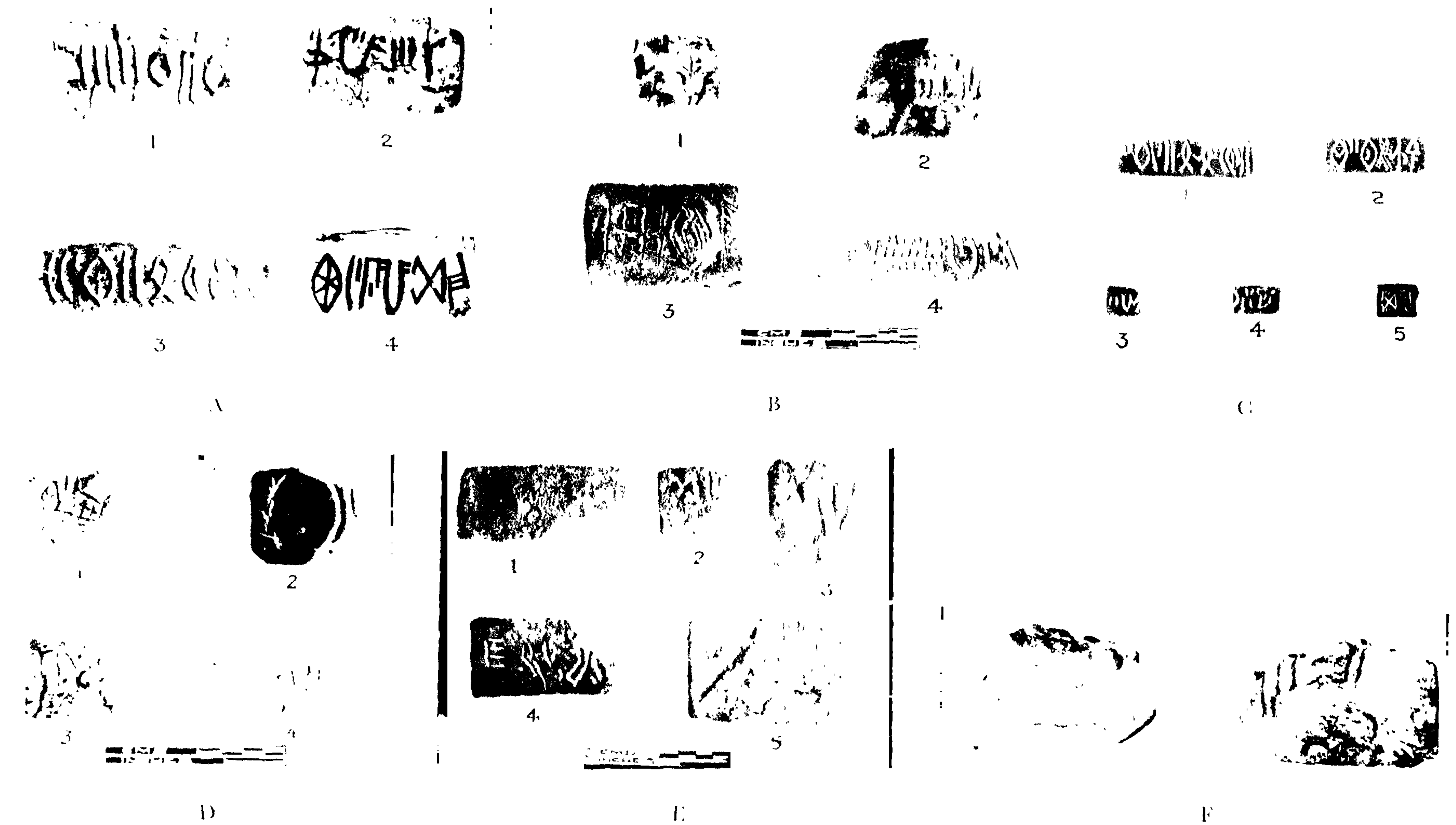


A

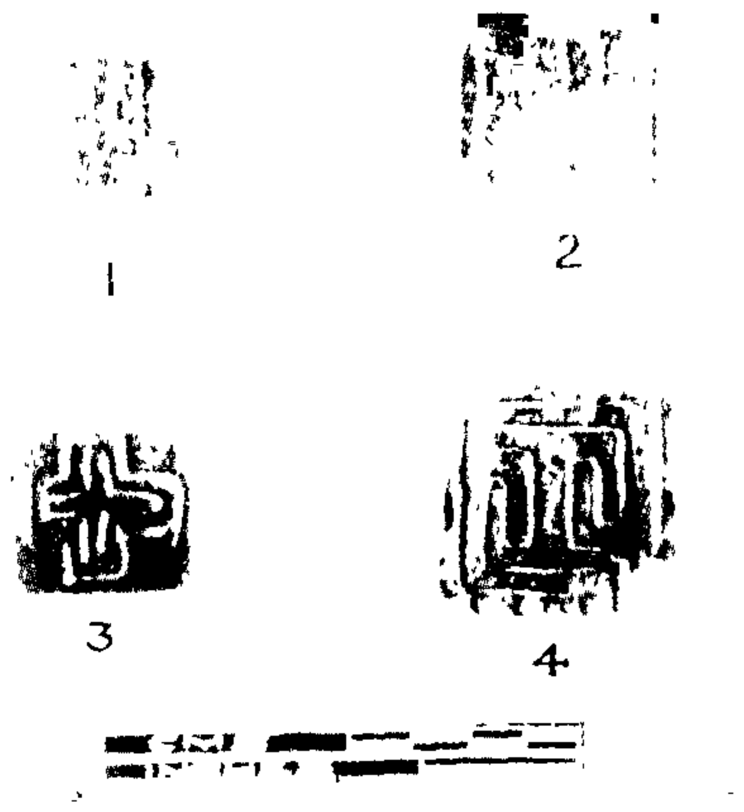
B

C

A, *Steatite seals, 1 with tiger (?) motif, 2 and 4 with Indus script and shorthorned humpless bull, 3 with Indus signs and goat, Scale 3/2;* B, *Terracotta seal with Indus script and humpless bull (?), Scale 3/2;* C, *Miscellaneous seals. 1 Indus script and anthropomorphic (?) figures, 2 Incised design, 3 Bird and Indus sign (?), 4 Unicorn above and Indus script below, 5 Seed-drill motif above and Indus script below. 1-2, 4-5 Terracotta, 3 Steatite, All unperforated, Scale 1/1.* *See pp. 312, 316 and 317*



A, Seals with Indus signs only, 1-3 soapstone, 4 agate. All unperforated seal, Scale 1/1 ; B, Terracotta seals with Indus script only ; C, Steatite seals with Indus script only, Scale 1/1 ; D, Seals with Indus script only, 1 and 3 soapstone, 2 steatite, 4 agate ; E, Terracotta seals with Indus script only ;
F, Soapstone seal (15264) reused by re-engraving unicorn. No perforation or boss, Scale 1/1. See pp. 311, 317 and 318


A

B

C

D

E

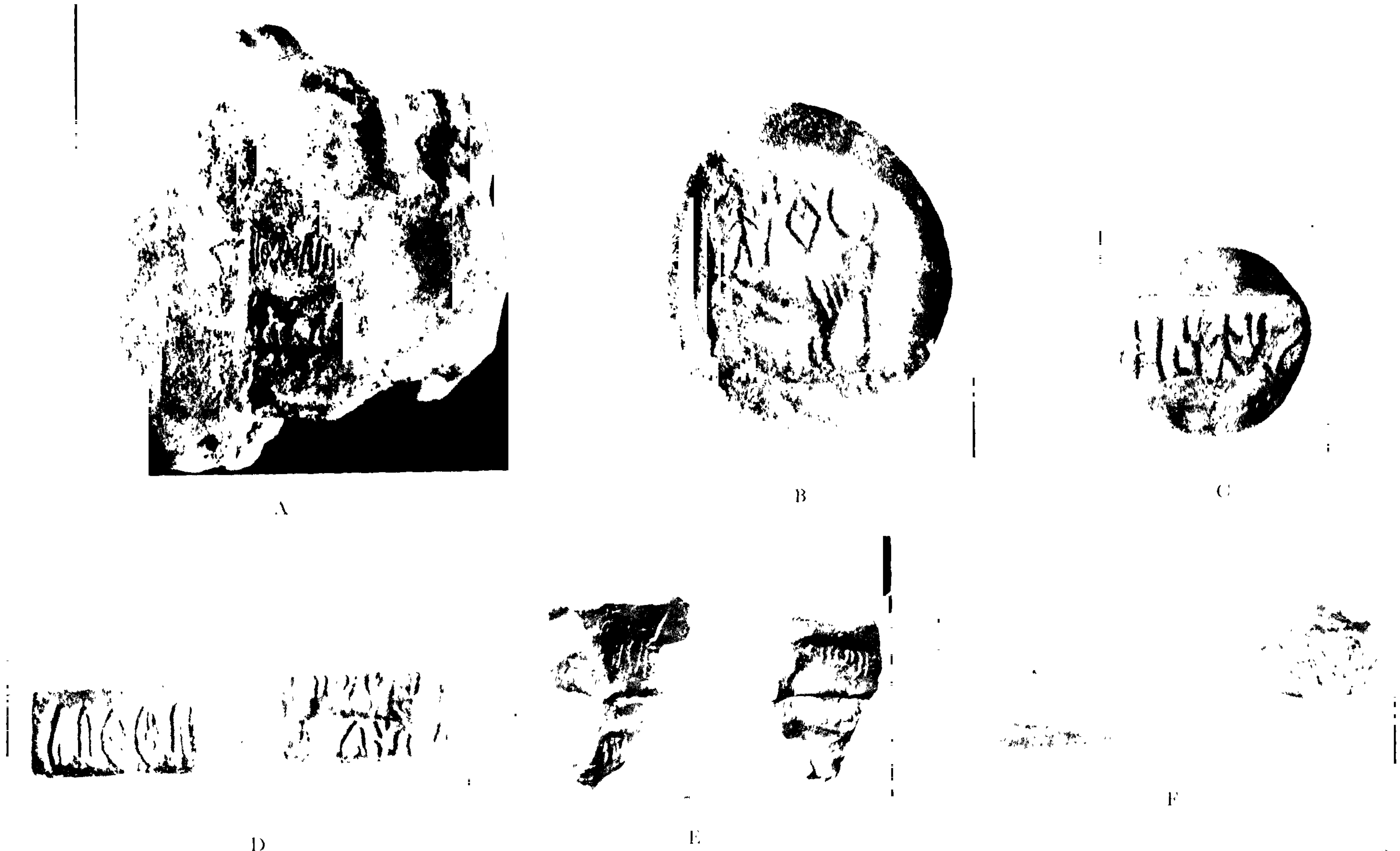
F

A. 1-2 *Seals with Swastika, 3 double cross, 4 geometric designs, 1-2 Faience, 3-4 steatite* ; B, *Circular steatite seal of Persian Gulf origin with jumping gazelles flanking a dragon, Scale* 1/1 ; C, *Impression of* B *above, Scale* 4/3 ; D, *Steatite seal with Indus script on the obverse and a perforated boss between two double circlets on the reverse, Scale* 1/1 ; E, *Terracotta sealing with Indus script and traces of unicorn on the obverse and textile impressions and marks of packing material (cord and reeds) on reverse, Scale* 1/1 ; F, *Terracotta sealing with Indus script and elephant on the obverse and finger impression and nail marks on the margin, Scale* 1/1. *See pp.* 305, 312, 318, 318 *and* 325

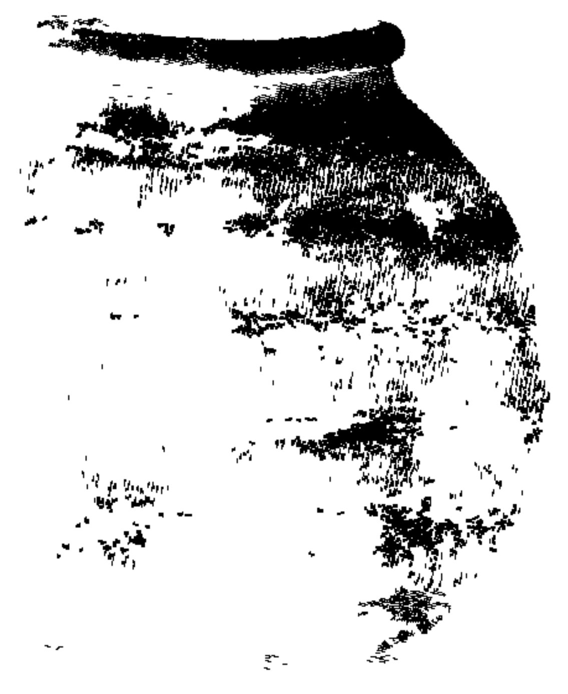
A, 1 *Terracotta sealing used as a jar-cover bearing two impressions of a seal with a multi-swastika motif.* 2 *Terracotta sealing with a compartmented square design.* B, *Terracotta sealing with Indus script and unicorn on the obverse and cord impressions on the reverse, Scale 1:1*; C, *Clay sealings each bearing two impressions of seals with Indus script and unicorn, 1 partly baked, 2 unbaked, Scale 1:2*; D, *Terracotta sealing with impressions of two different seals on the obverse and a deep groove on the reverse, Scale 3:8*; E, *Terracotta sealing bearing impressions of three seals on the obverse and deep reed marks on the reverse, Scale 1:2*, F, *Terracotta sealing with a cross enclosed by a decorative border, Finger impressions also visible, Scale 1:1.* *See pp. 305, 319, 321, 322, 325 and 326*

PLATE CLXIII

A, Terracotta sealings with Indus script and unicorn on the obverse, (Reed-impressions on reverse), Scale 1/1; B, *Terracotta sealings with Indus script and unicorn partially obliterated by finger impressions, Scale 1/1;* C, *Terracotta sealings with bull Scale 1/1;* D, *Terracotta sealings with Indus script, 1 with impressions of three seals, 2 and 3 with impressions of two seals, Scale 3/4;* E, *Terracotta sealings bearing impressions of the same seal, (Reed marks on the reverse), Scale 1/1;* F, *Terracotta sealing with impressions of four seals two on each side, (Reed marks on the back), Scale 9/8;* G, *Terracotta sealing with three impressions of a square seal, Scale 1/1. See pp. 320, 326 and 327.*

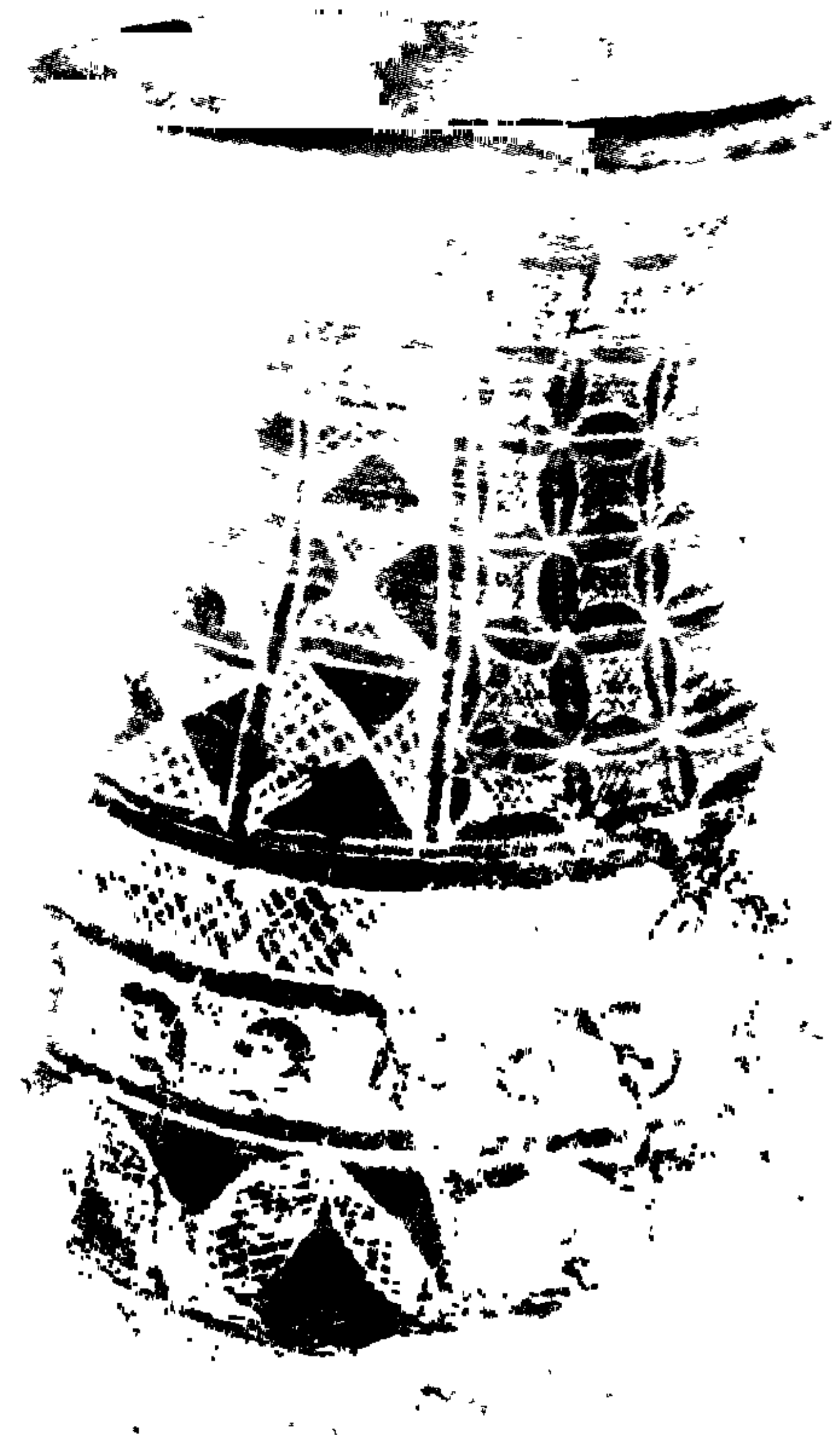


A, Terracotta pellet bearing impression of a seal, with Indus script and unicorn. Scale 1:1; B, Clay sealing with Indus script and a composite animal. Scale 3/2; C, Terracotta sealing with Indus script and unicorn. (Impression of cloth on the back) Scale 9:8; D, Faience sealing with Indus script, short-horned bull and unicorn on one side and Indus script on the other. Scale 9:8; E, Terracotta sealings, the larger bearing impressions of five seals and the smaller three only. (Reed marks on reverse). Scale 1:1; F, Oval-shaped terracotta sealings with Indus script. Unicorn partially visible. Scale 5:4. See pp. 305, 321, 322, 324, 327 and 328

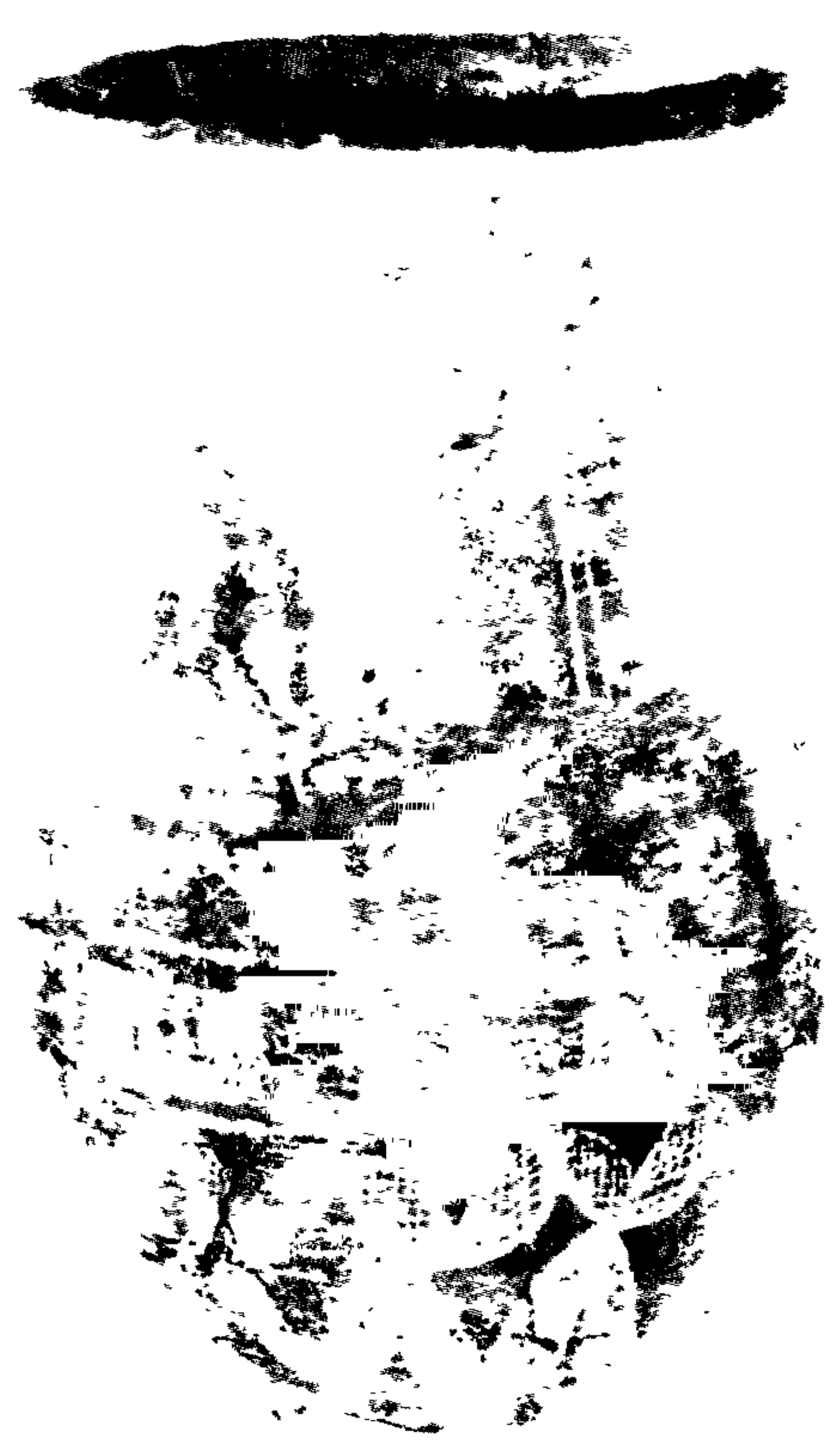


A

B

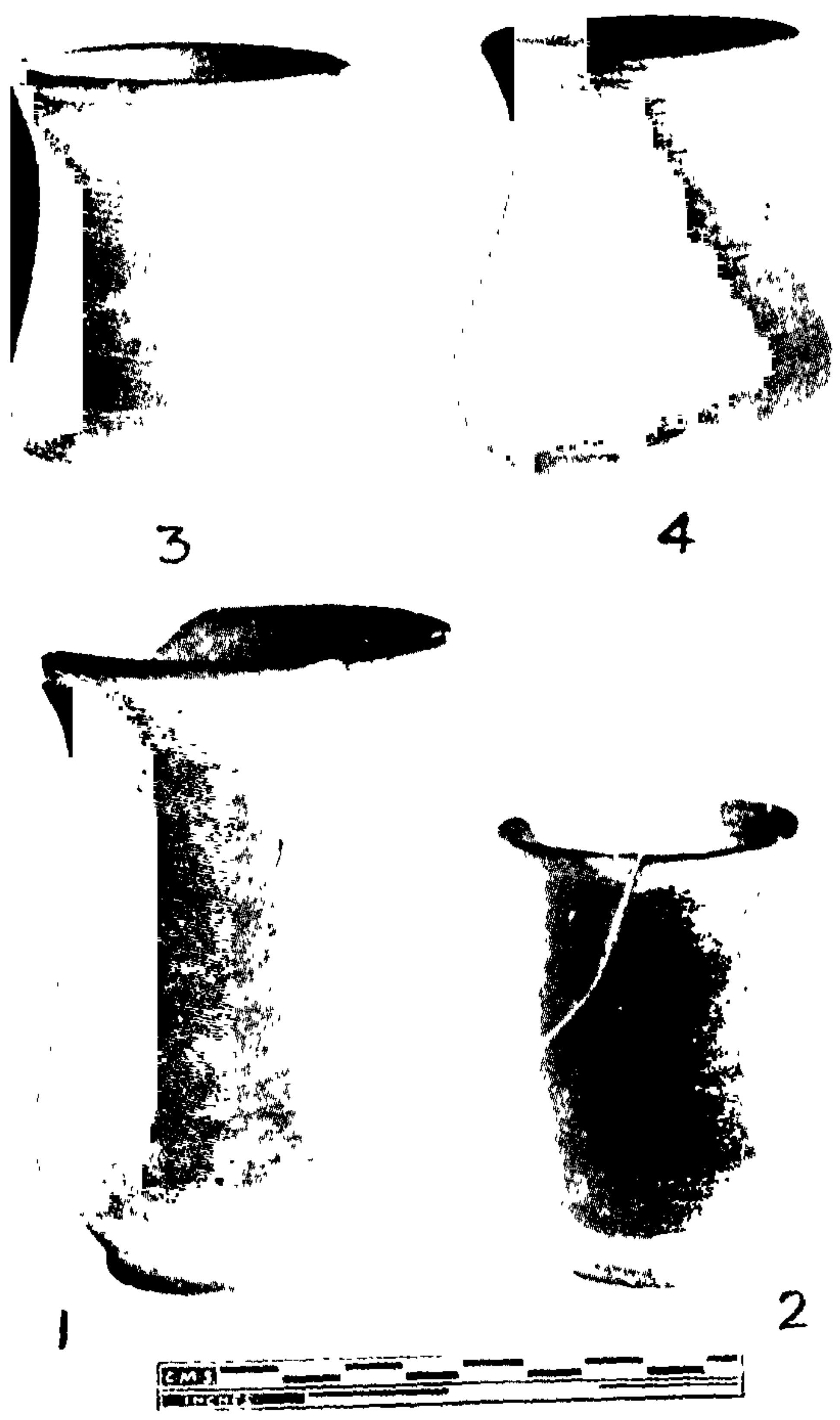


C



D

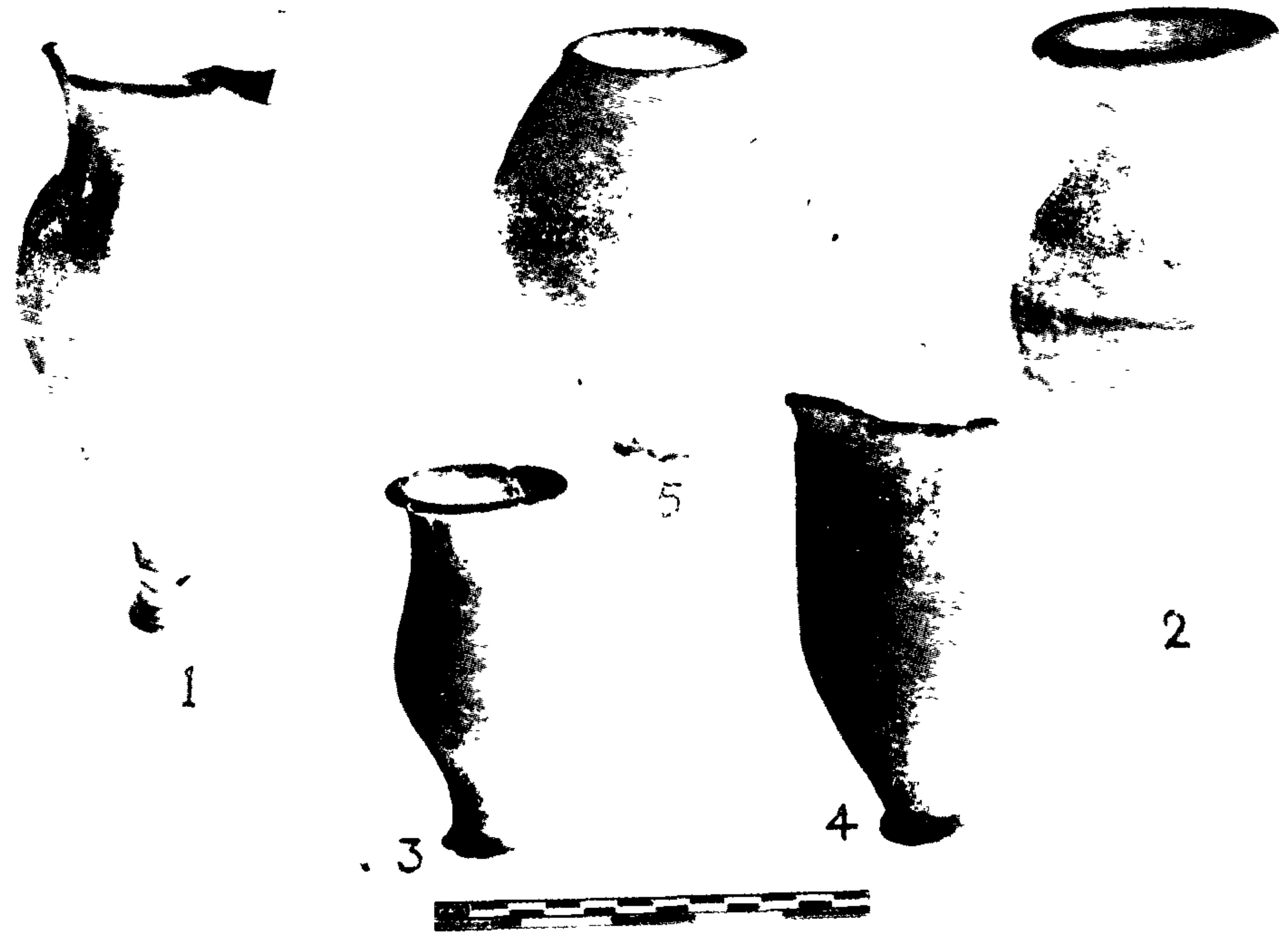
A, *Storage jar Type 3. Red Ware, Period A. Scale 1/10*; B, *Storage jar Type 5. Red Ware, Period A. Scale 1/10*; C, *S-shaped jar Type 9. Red Ware, Period A. Indus style painting. Scale 1/10*; D, *Another view of Type 9. Provincial style painting. Scale 1/10. See p. 354*



A B

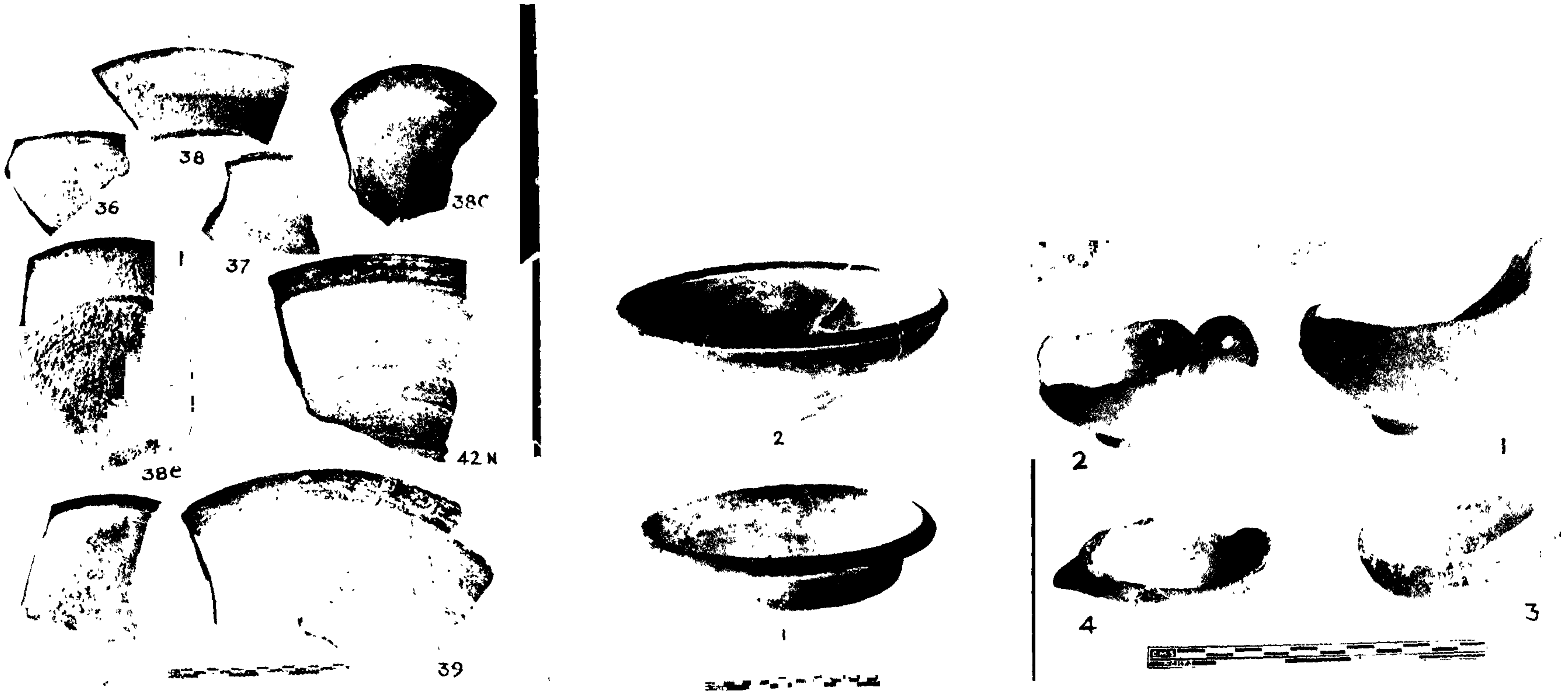
A, *Painted jar from fire-altar, Type 9a, Red Ware, Period A, (Scale of foot and inches)*; B, *Beakers, 1-2 Types 35a and 35d Red Ware, 3-4 Types 98a-b Buff-slipped ware, Period A. See pp. 360, 362 and 380*

A



B

A, *Vases*, 1-3 *Types* 28-30 *Red Ware*, *Period A* ; B, *Vases*, 1-4 *Types* 30*a-d* ; 5 *Type* 3*a all Red Ware*, *Period A*. *See p.* 362

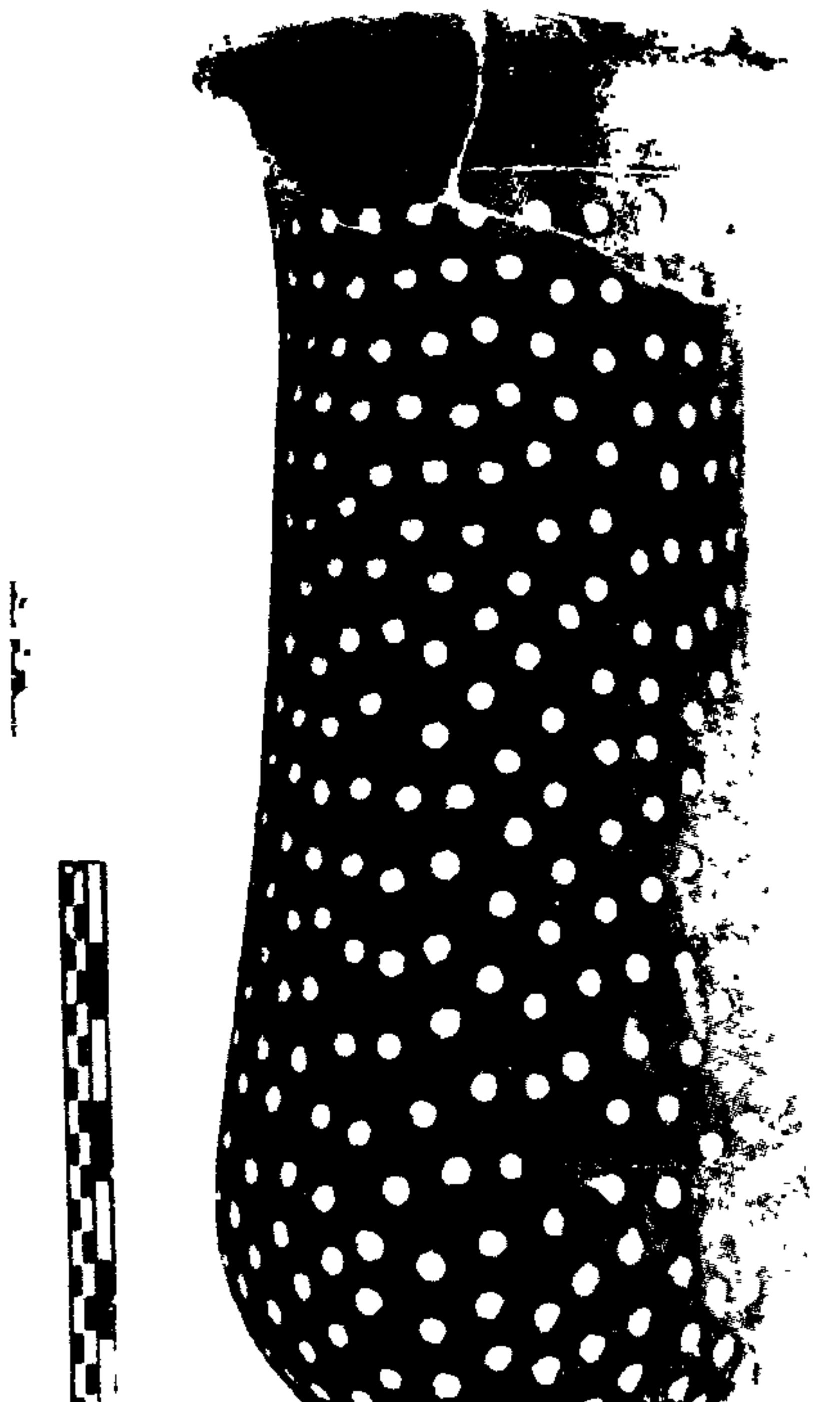


A B C

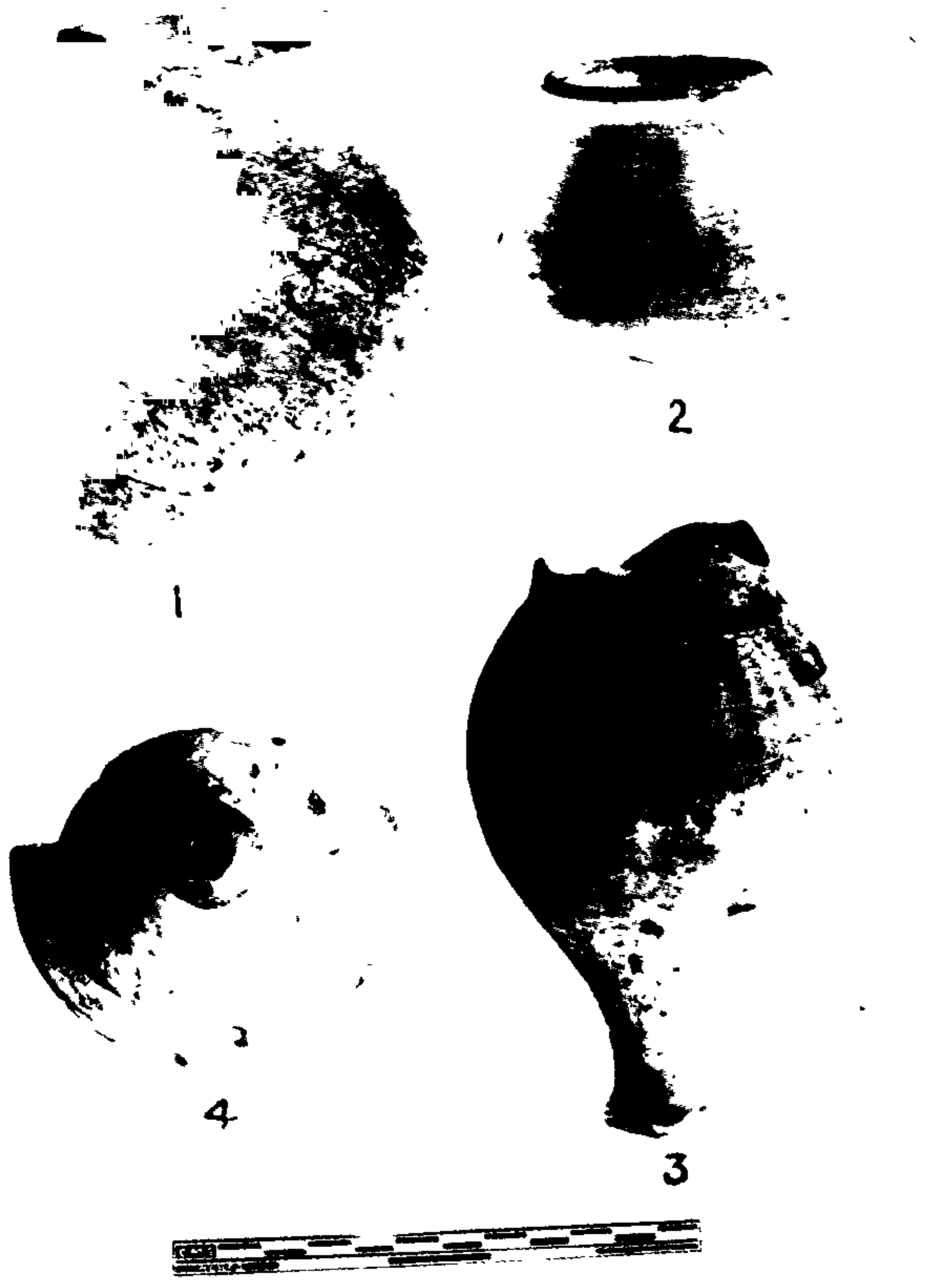
A, *Dishes. Types* 38-42. B, *Basins*, 1 *Type* 53*a Red Ware*, 2 *Type* 107 *Buff-slipped ware, Period A*; C, *Cups and lamps*, 1-2 *Types* 66 *and* 66*a*, 3-4 *Types* 67 *and* 68 *all Red Ware. Period A. See pp.* 366, 369, 373 *and* 380

A

B



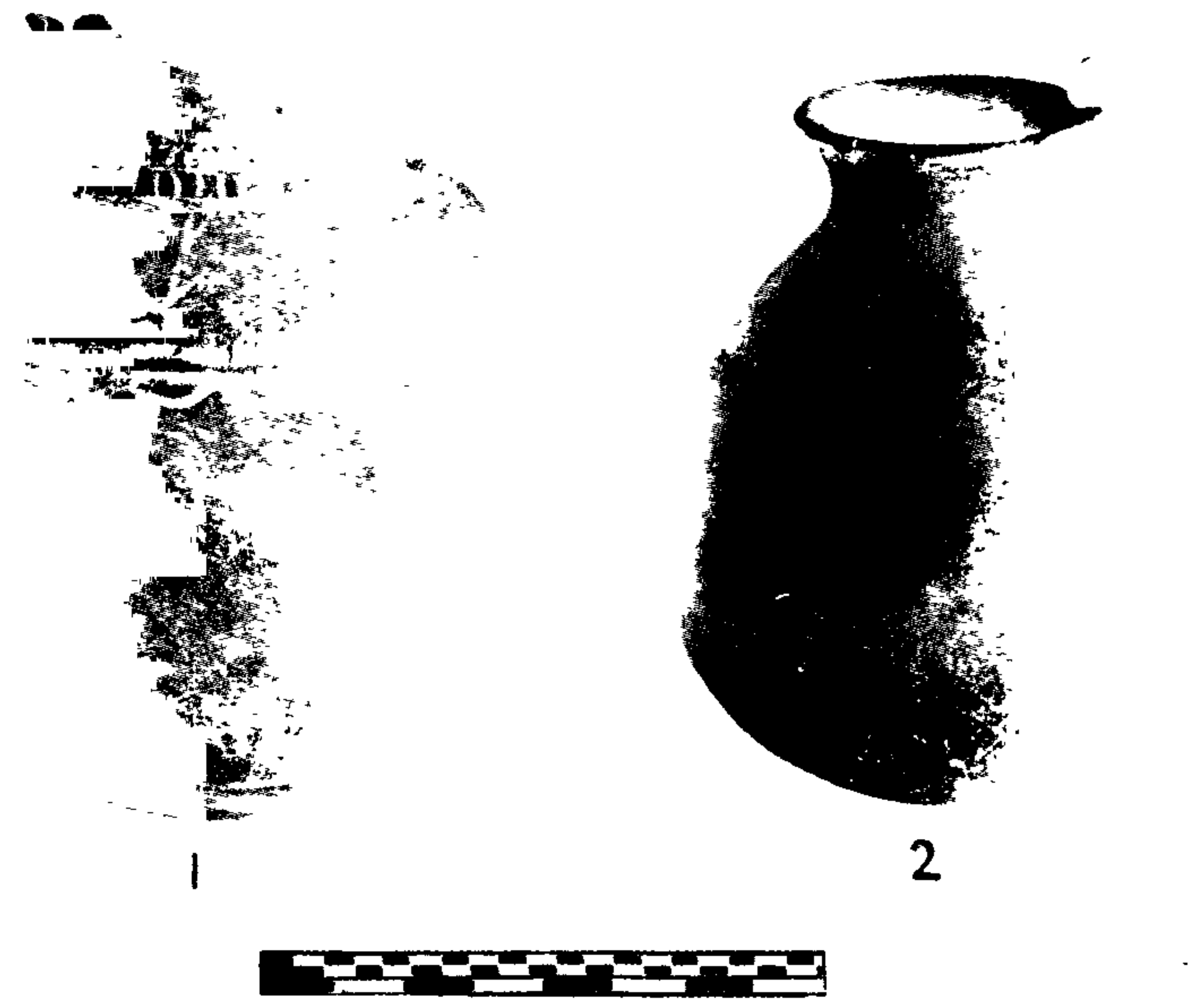
C



D

A. Basin, Type 83 Buff-slipped ware, Period A ; B. Lamp with concentric walls, Type 125 Buff-slipped ware, Period A ; C. Cylindrical perforated jar, Type 95 Buff-slipped ware, Period A ; D. Jars, goblet and lid, 1-2 Types 173 and 173 a ; 3 Type 174 ; 4 Type 179 all grey ware Period A.

See pp. 375, 380, 383 and 393



A

B

A, *Jars, 1-2 Types 181h and 181j Micaceous Red Ware, Period A*; B, *Bowls, Black-and-red ware, 1-9 Period A; 10-11 Period B. See pp. 395 and 405*

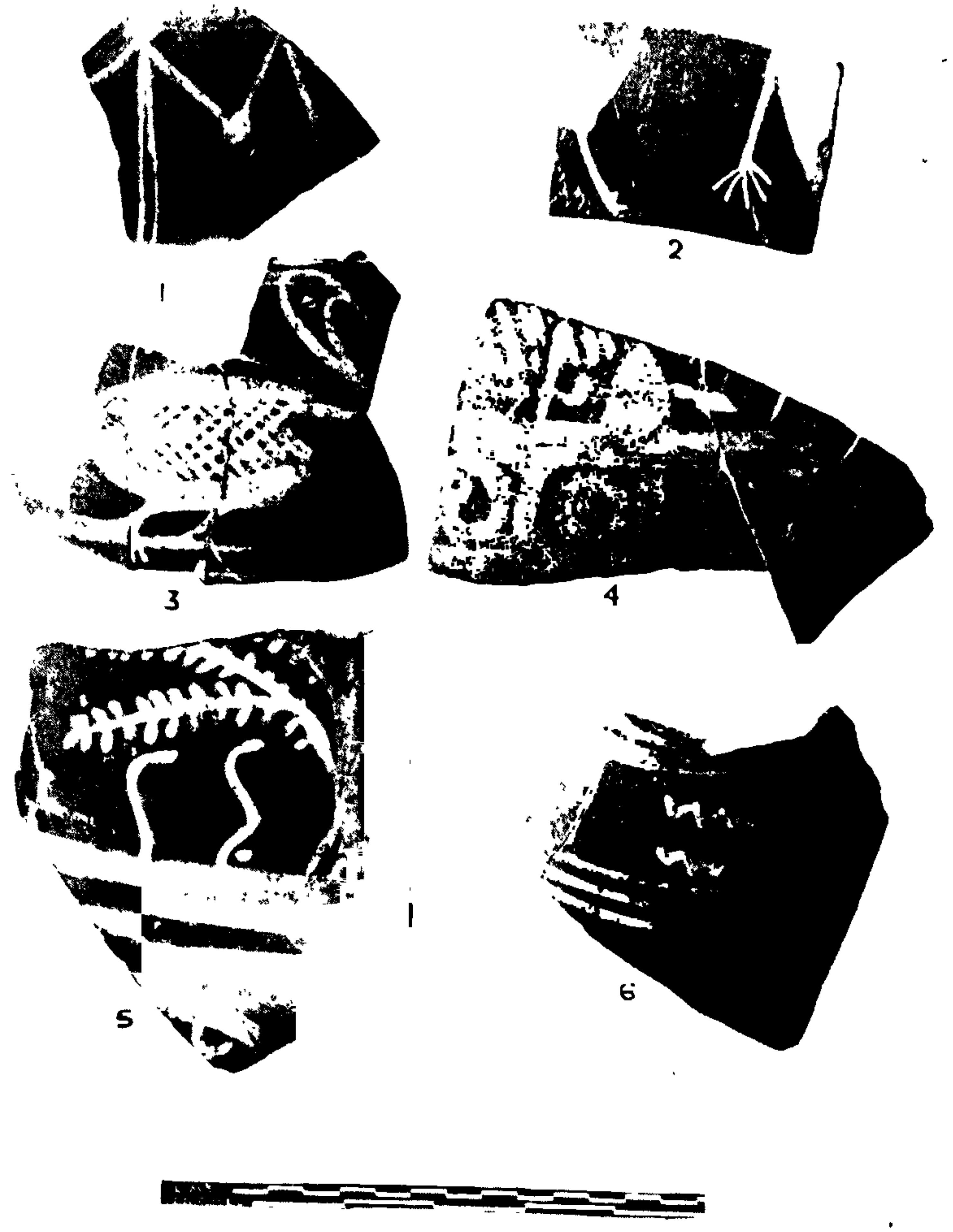
A

B

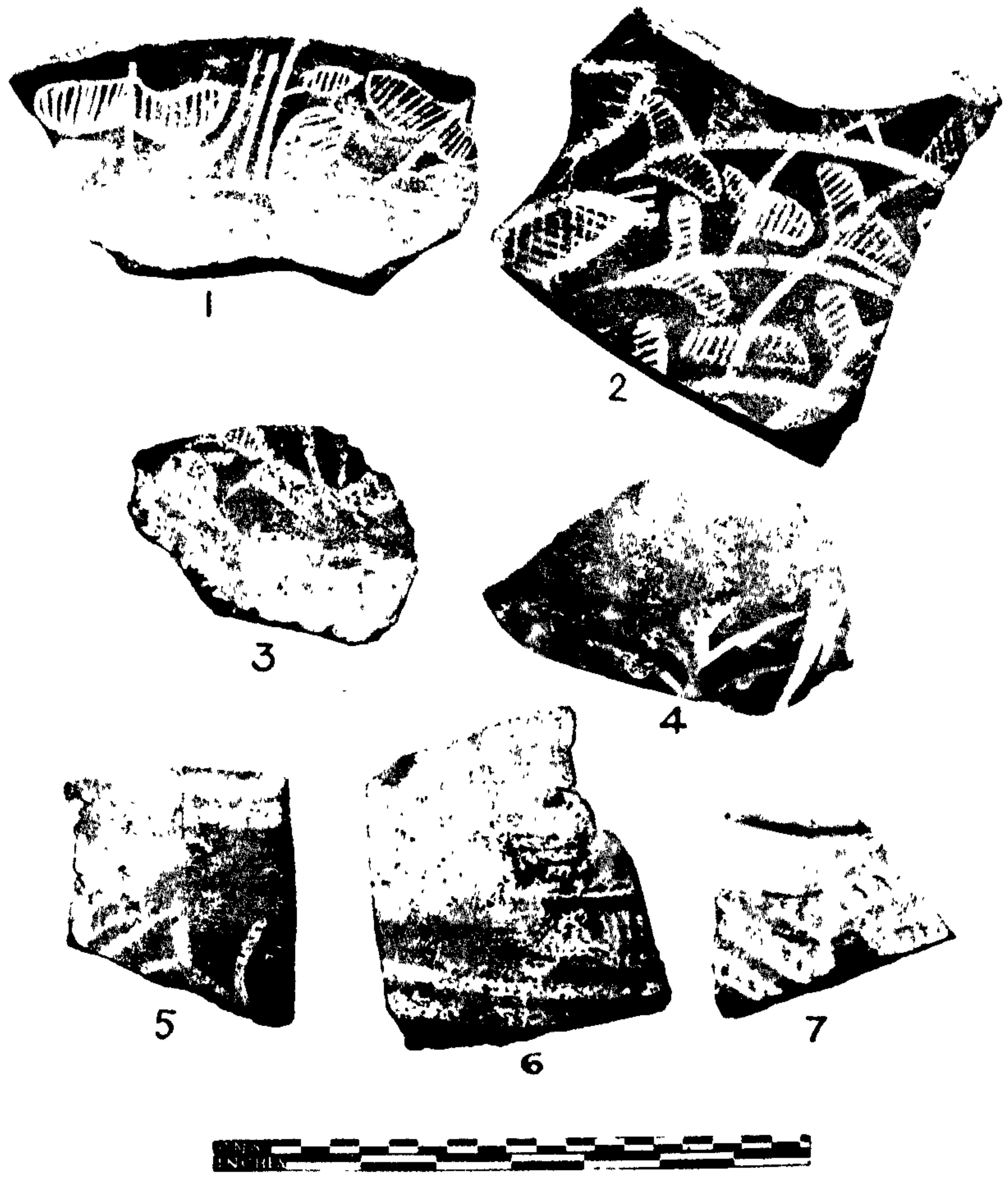
C

A, Sea animal painted in provincial style, Period A, Scale 3/2. B, Fluttering birds holding fish provincial style Period A; C, Cranes painted in provincial style Period A. *See p. 346*

PLATE CLXXII

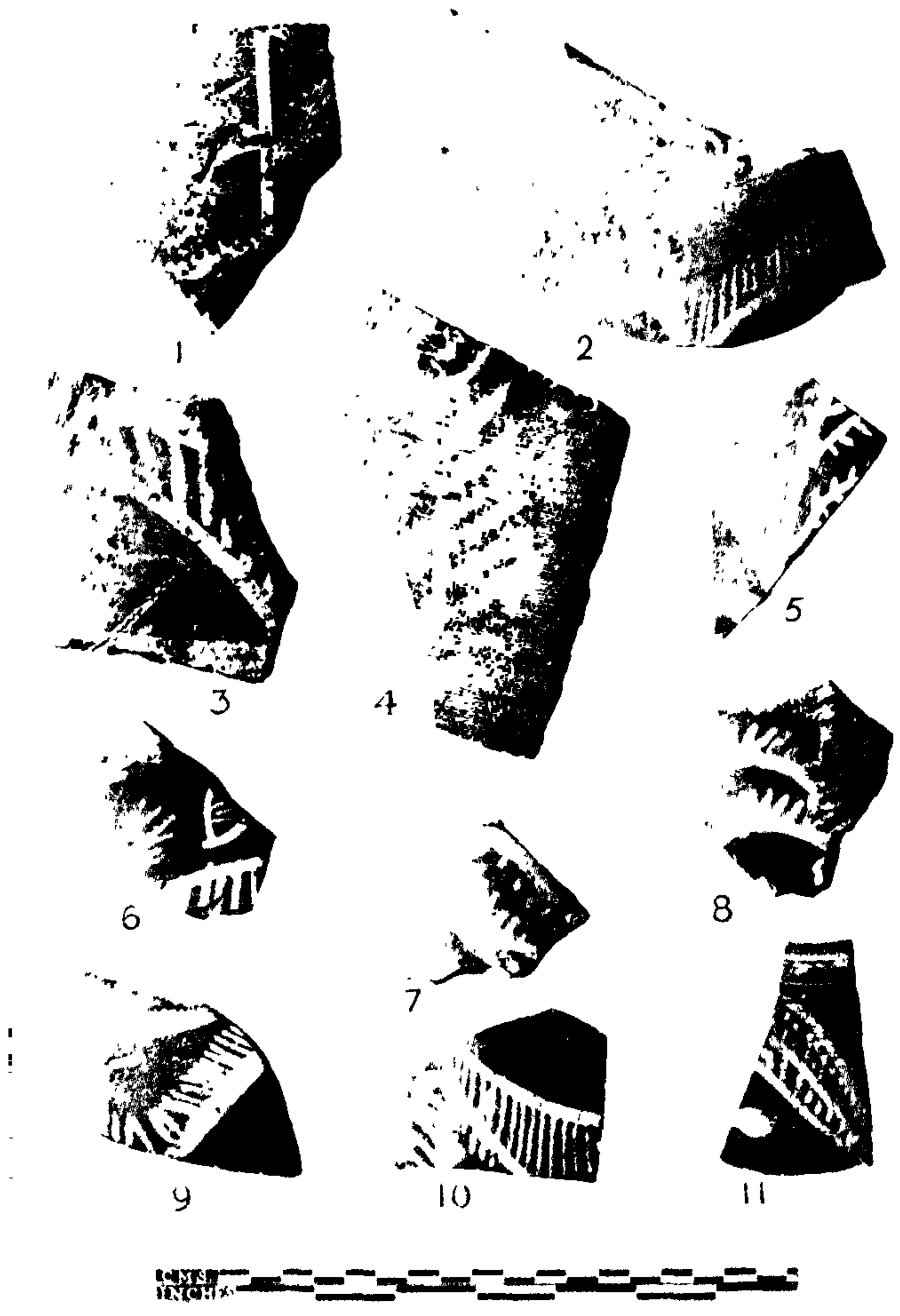


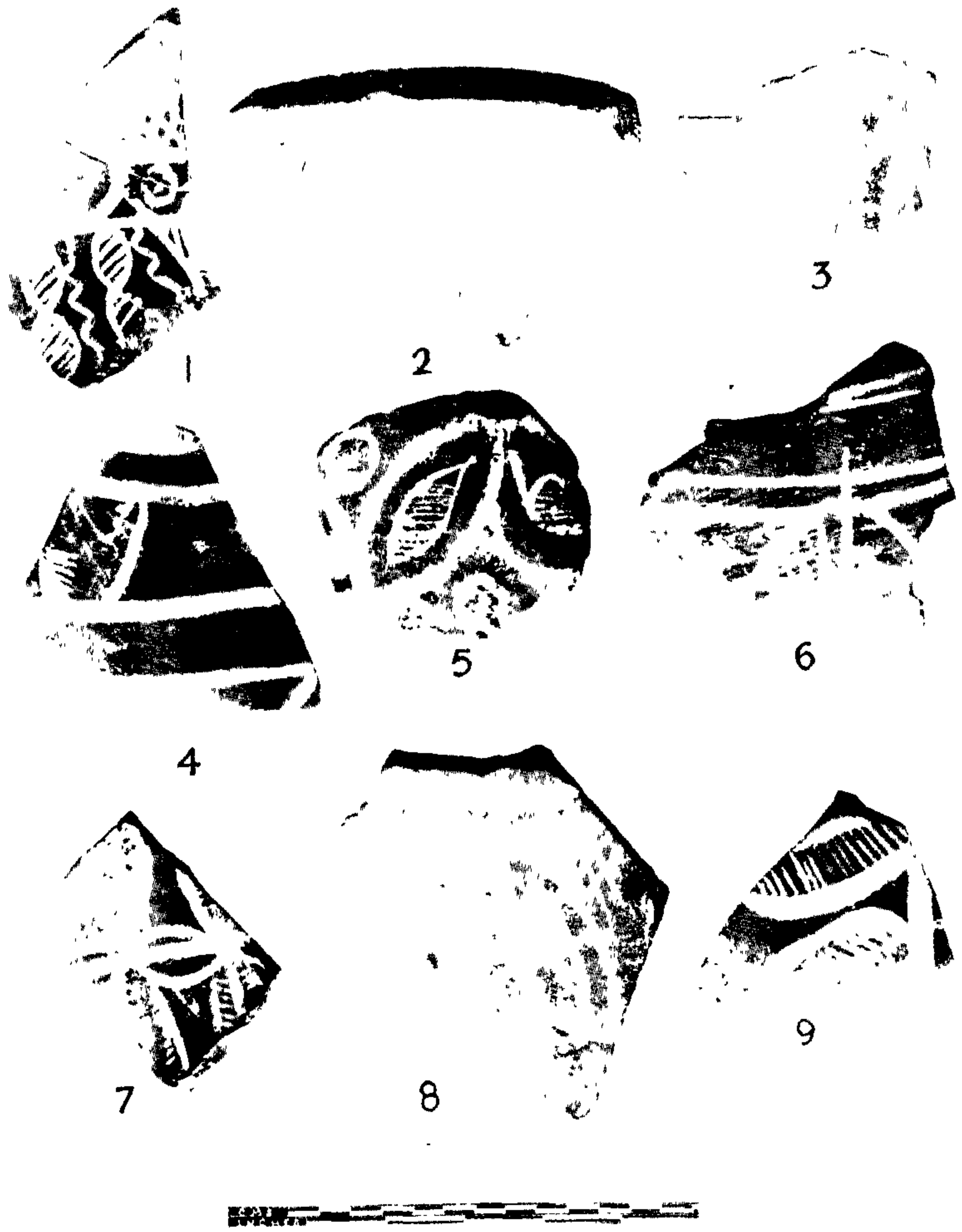
A



B

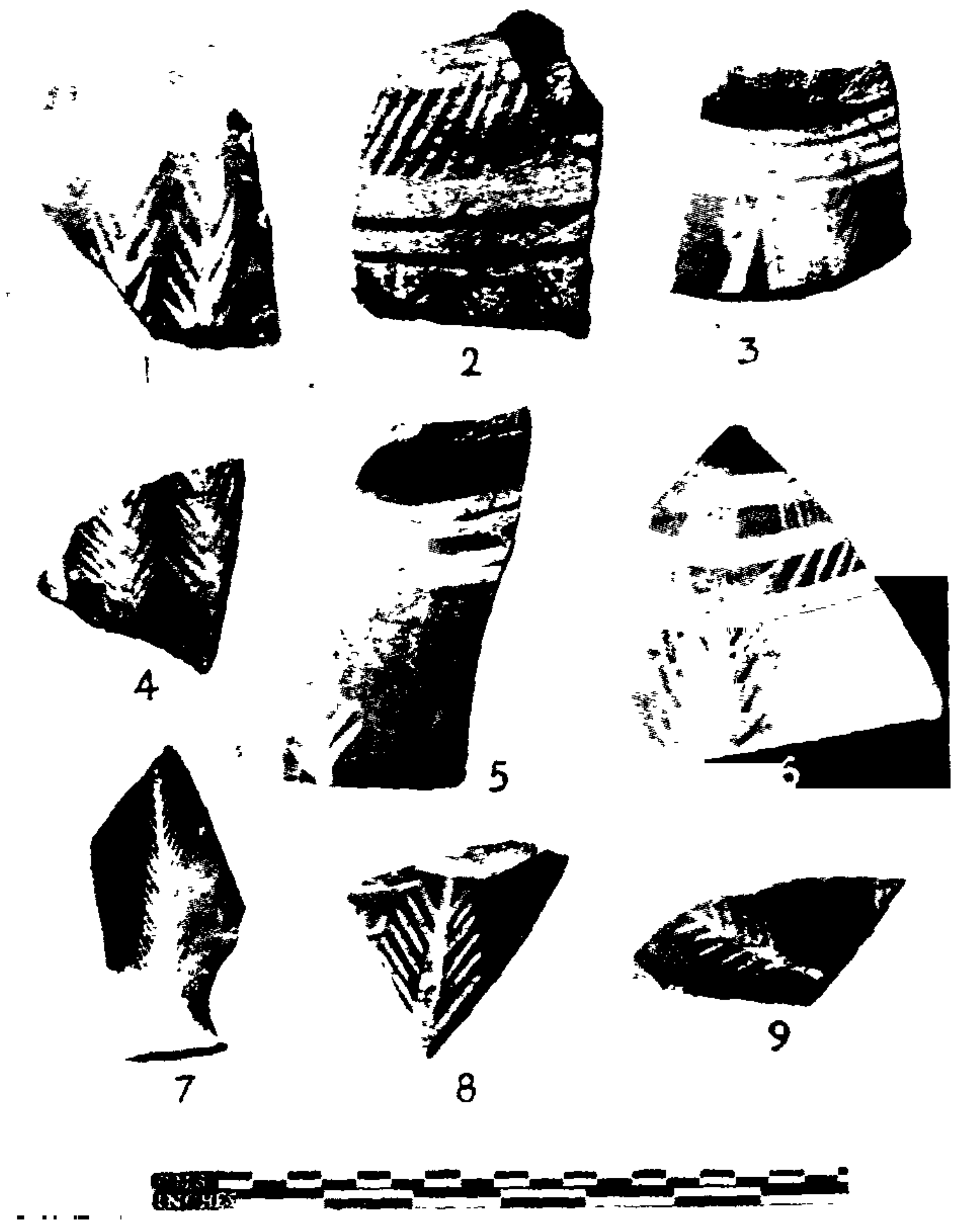
A. *Painted pottery from Period A : 1 dancing human figures ; 2 birds, 3 Peacock, 4 snakes and anthill, 5-6 snakes, 2 and 5 painted in provincial style ; 3 in Indus style ;* B. *Vegetable motifs painted in Indus style. Period A. See pp. 316, 317, 107 and 109*





A B

A. *Painted pottery, Vegetable motifs Period A.* B. *Semi-naturalistic patterns; Painted in Indus style Period A.* *See pp. 108 and 109*



A

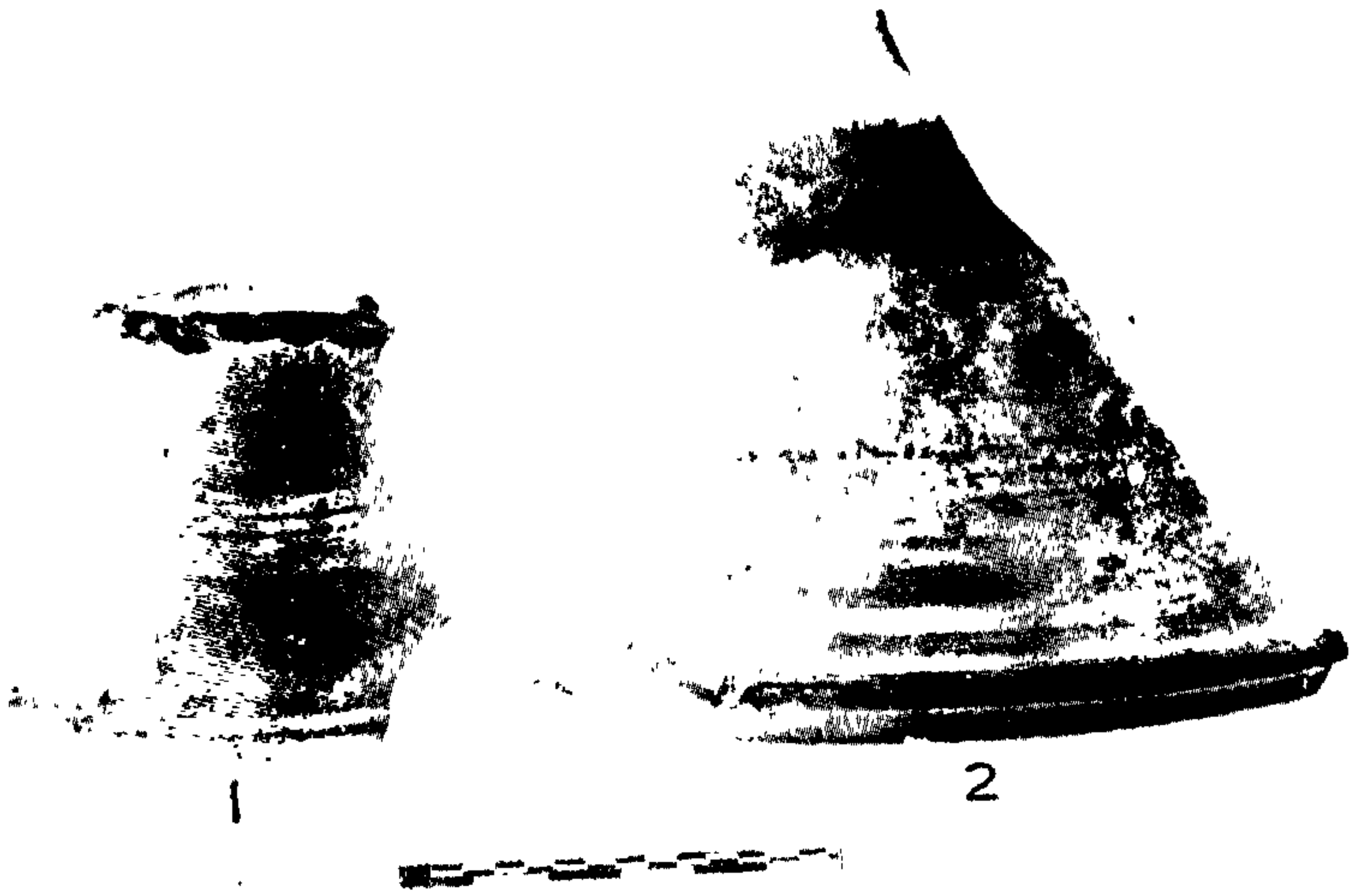
B

A, Naturalistic motifs painted on Micaceous Red Ware Indigenous style Period A : B, Miniature jar Story of 'thirsty deer and bird' painted in provincial style Period A. See pp. 411 and 412

A

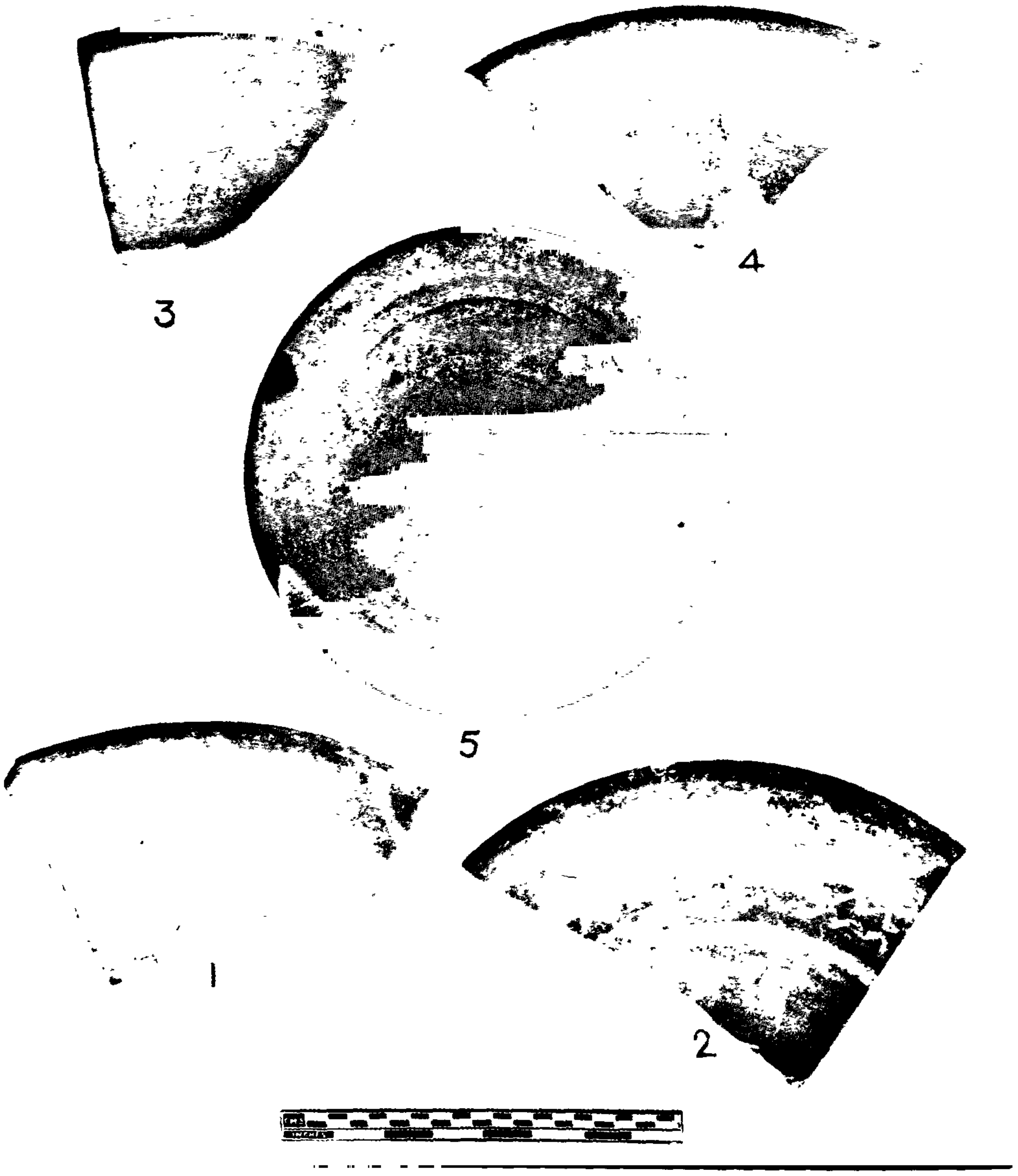
B

C



D

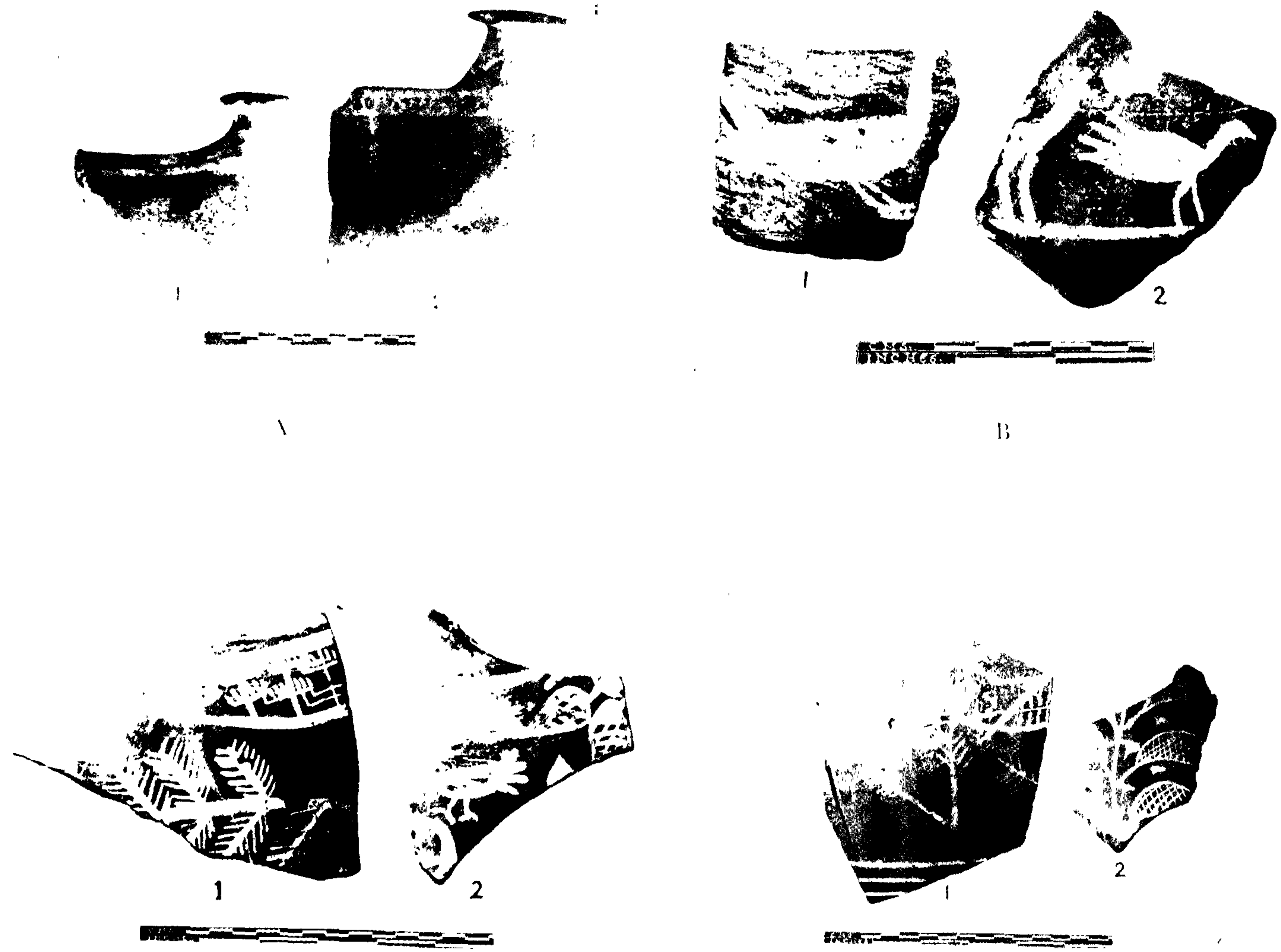
A. *Multi-oared boats painted on Micaceous Red Ware Period A* ; B. *Painted sherds* , *Geometric and linear pattern Period A* ; C. *Stand of a large dish-on-stand with a central hole Period B* ; D. *Stands of dishes-on-stand without perforation Period B.* *See pp. 412, 117, 121 and 124*



A

B

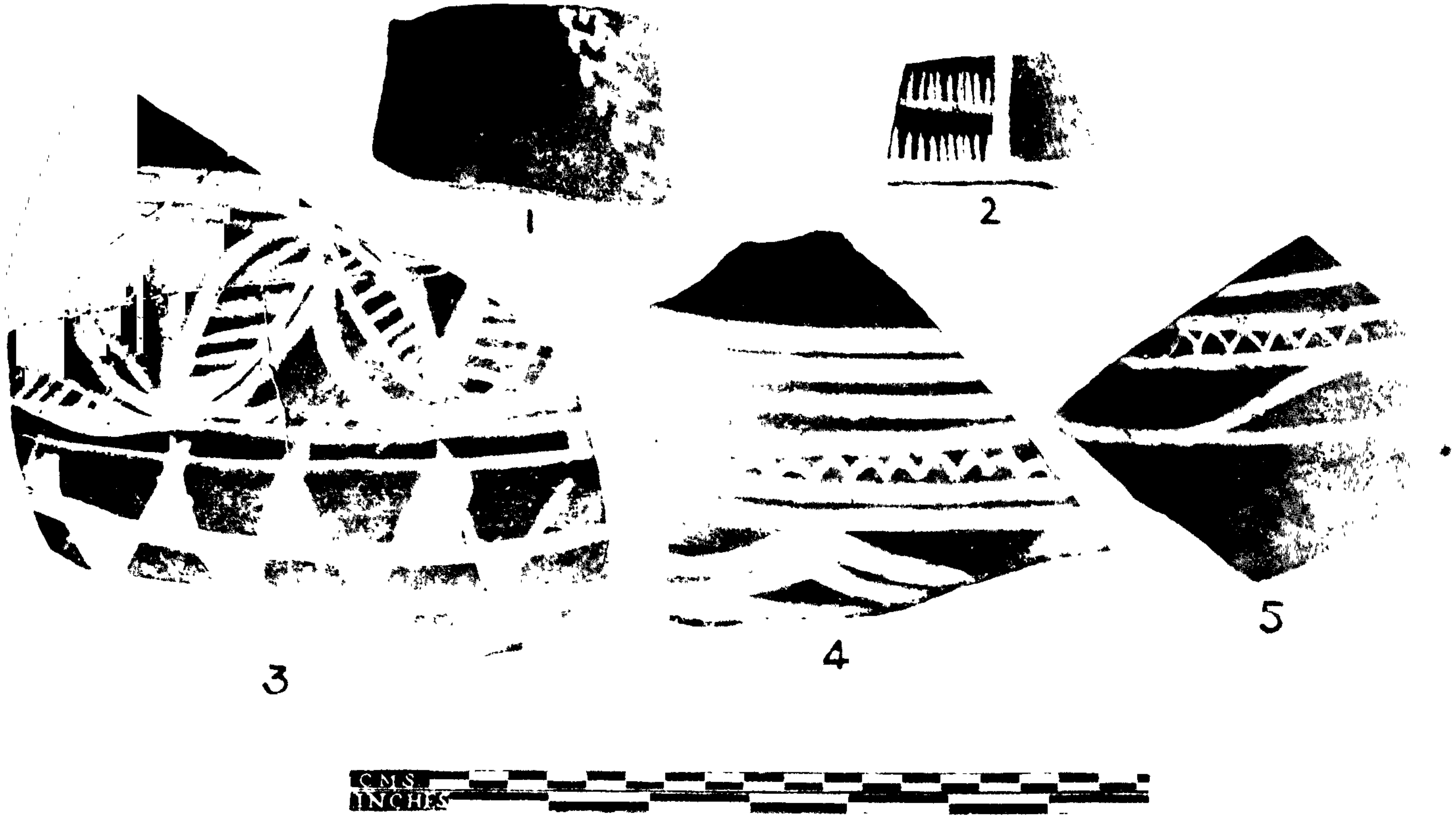
A. *Dishes. Plain and painted Period B* ; B. *Dishes plain* ; *Scale 1/5. See pp. 424 and 427*



A B C D

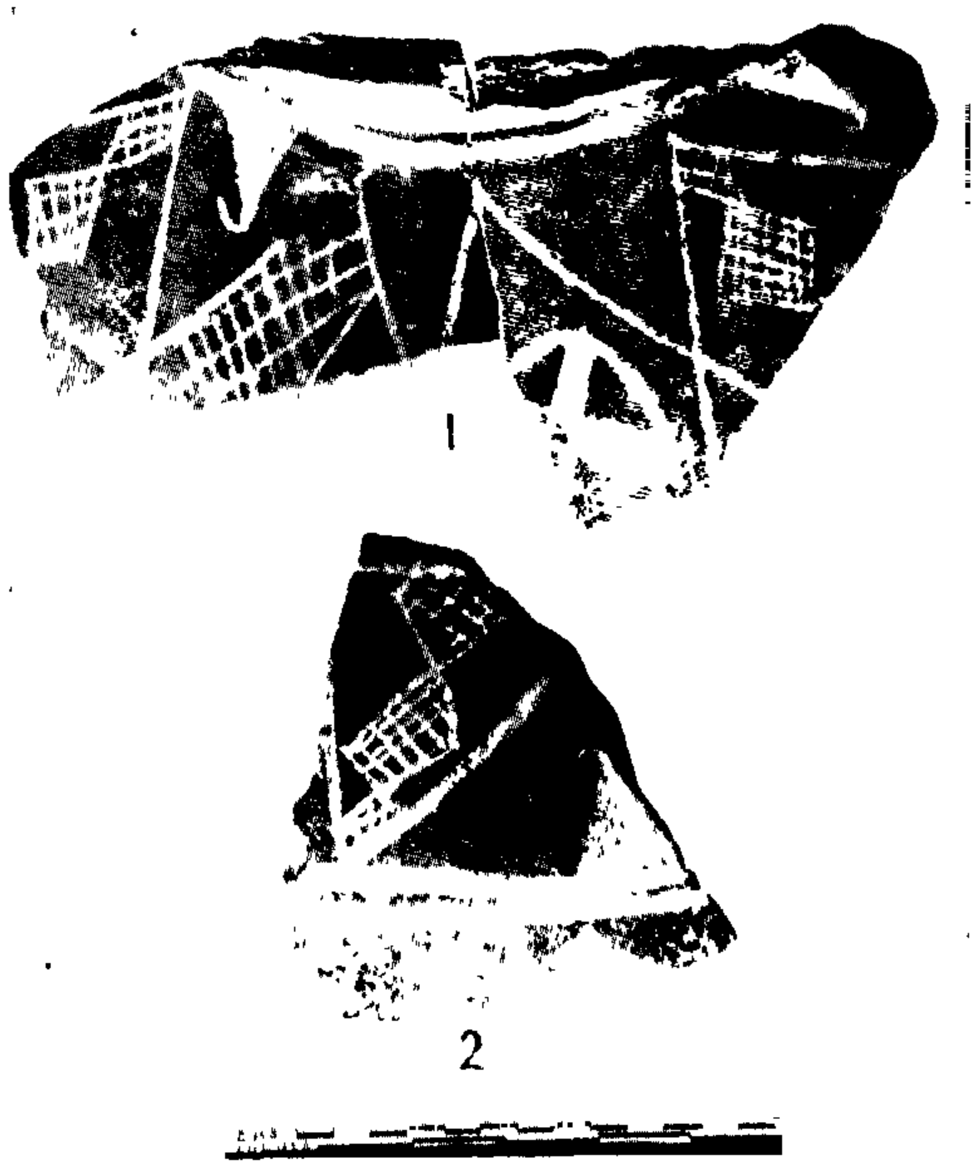
A. *Bowls with stud handle Period B.* B. *Painted pottery. Stylised bird motifs; 1 peacock, 2 Birds chasing one another. Period B.* C. *Painted pottery. Birds and foliage Period B;* D. *Painted pottery. 1 stylised bird and fish motifs. 2 palm tree and birds in Indus style Period B.* *See pp. 317, 130, 132 and 135*

PLATE CLXXVIII

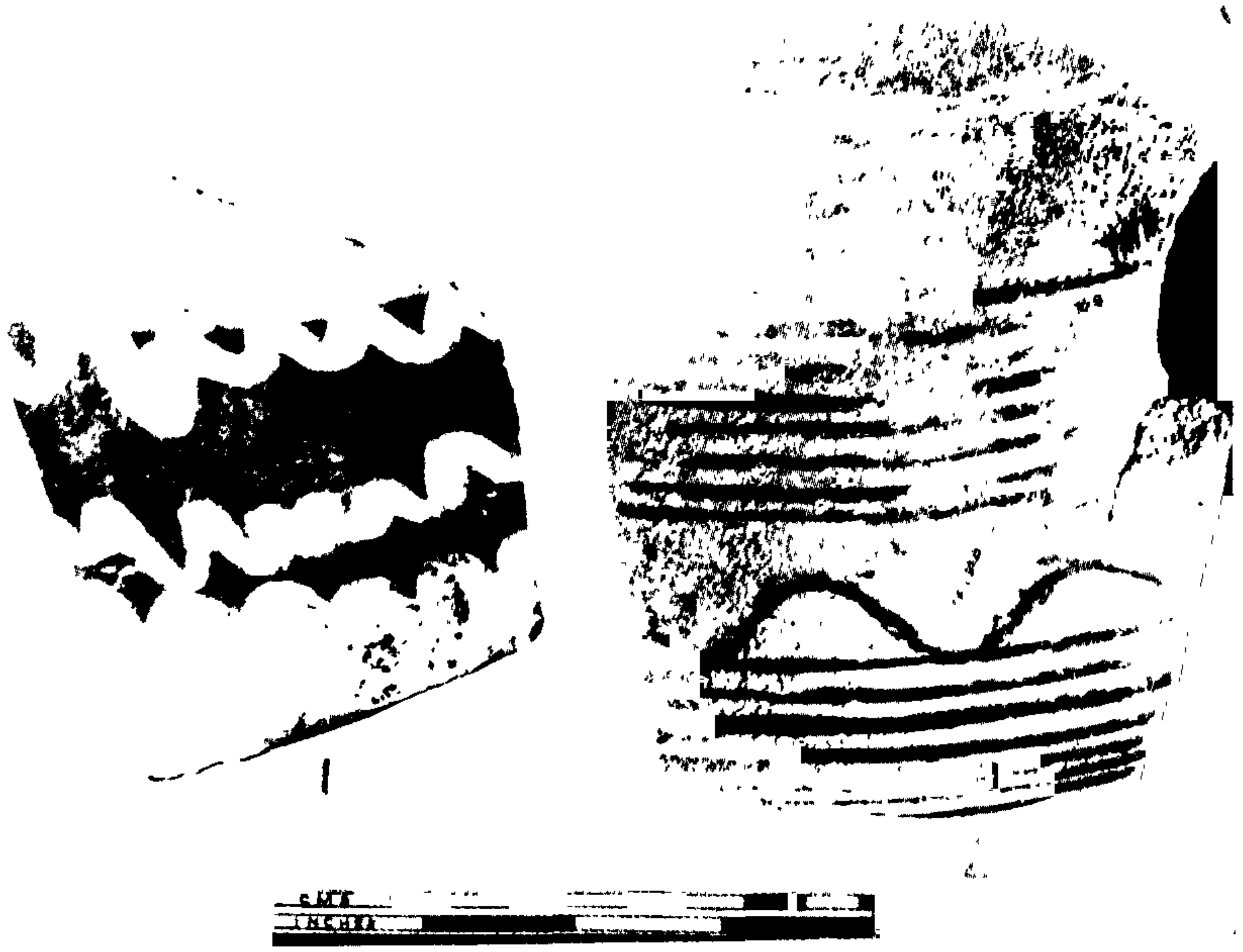


Painted sherds. Derived leaf patterns etc. Period B. *See p. 436*

A



B



C

A. *Painted pottery, plant motifs Period B.* B. *Painted pottery, hatched diamonds, filled triangle with hook and wheel design Period B;* C. *Painted pottery, wavy lines etc. Period B. See pp. 135, 138 and 140*

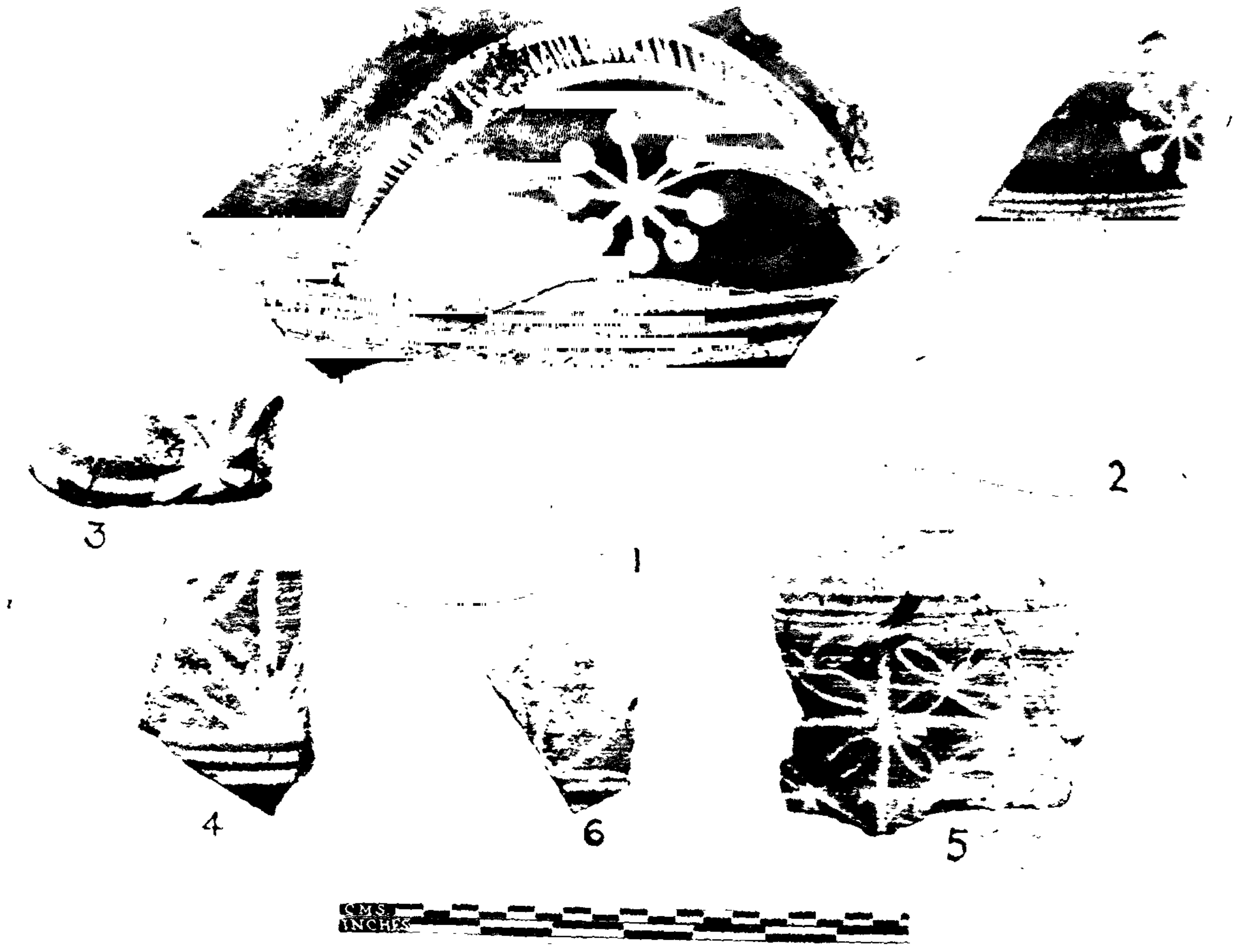
PLATE CLXXX

Painted pottery. Vertical wavy lines in groups. Period B. See pp. 347, 349 and 440

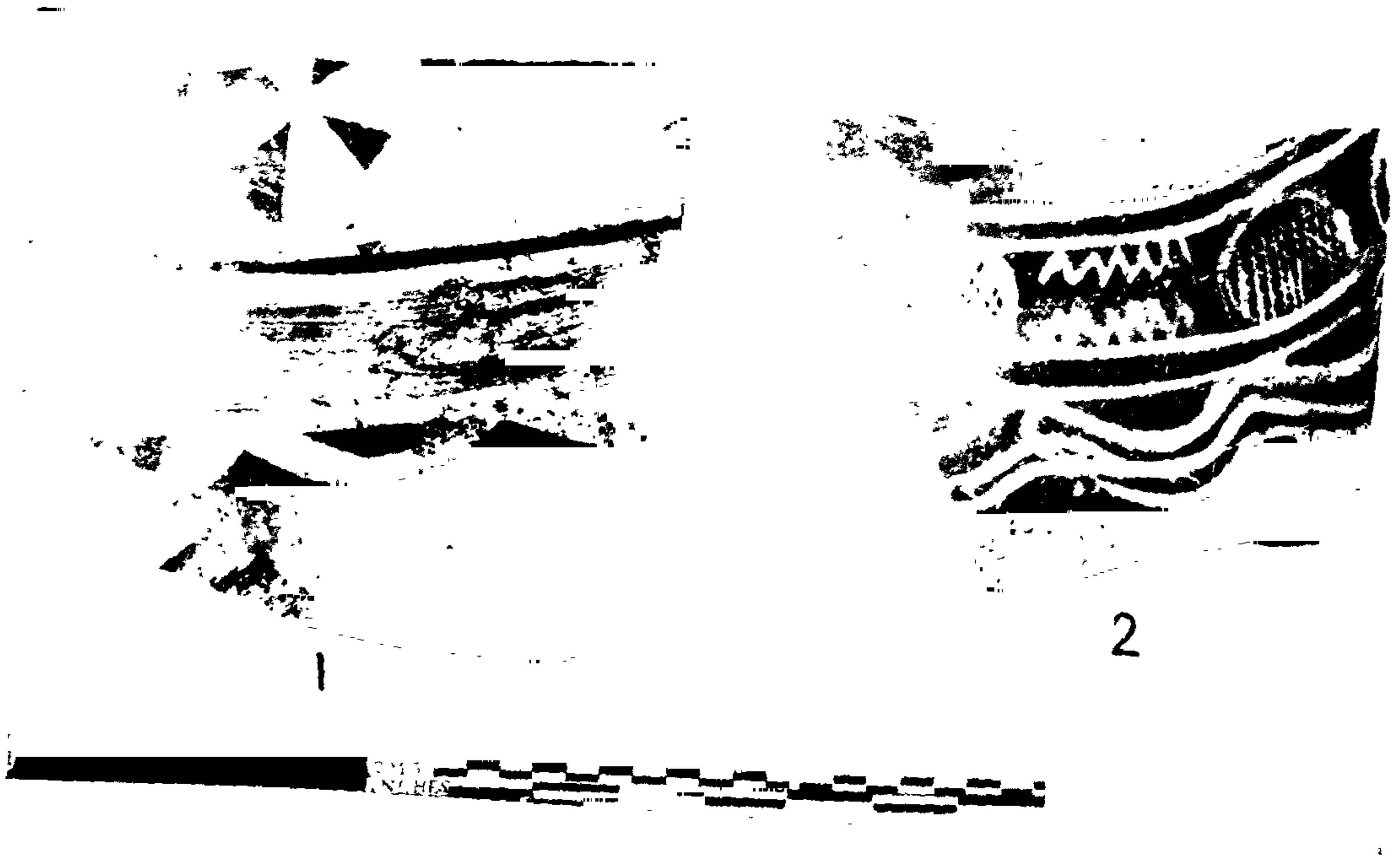
A

B

A. *Painted pottery. Interlacing loops etc. Period B.* B. *Painted pottery loops with fronds hatched interspaces etc. Period B.* *See pp. 347 and 349*



A

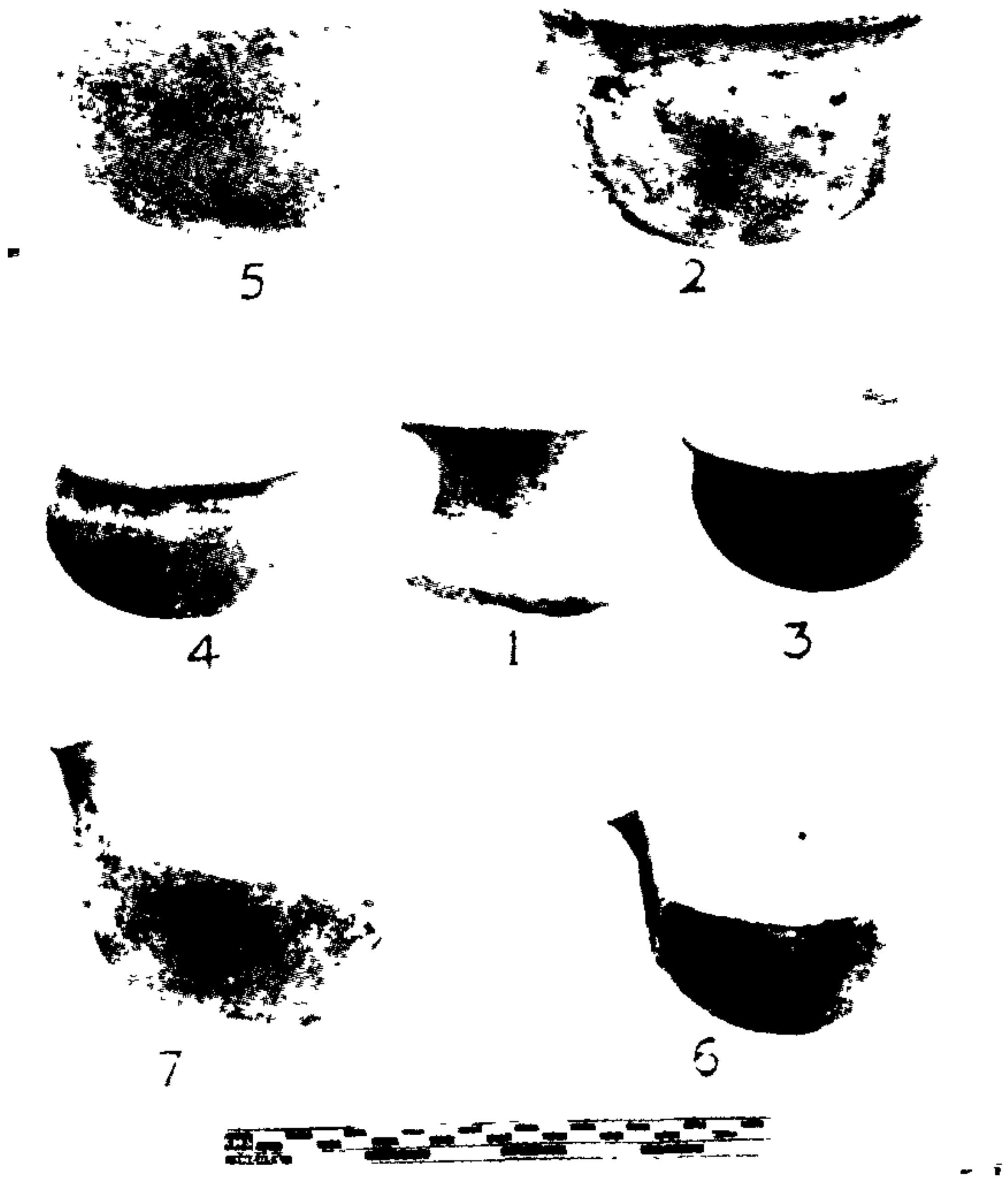


B

A. *Painted pottery. Hatched leaf: intersecting arcs and derived floral patterns: 3-5 Harappan motifs in Period B*: B. *Painted pottery. Wheel: wavy lines and hatched circles Period B. See pp 347, 447 and 449*

A

B



C

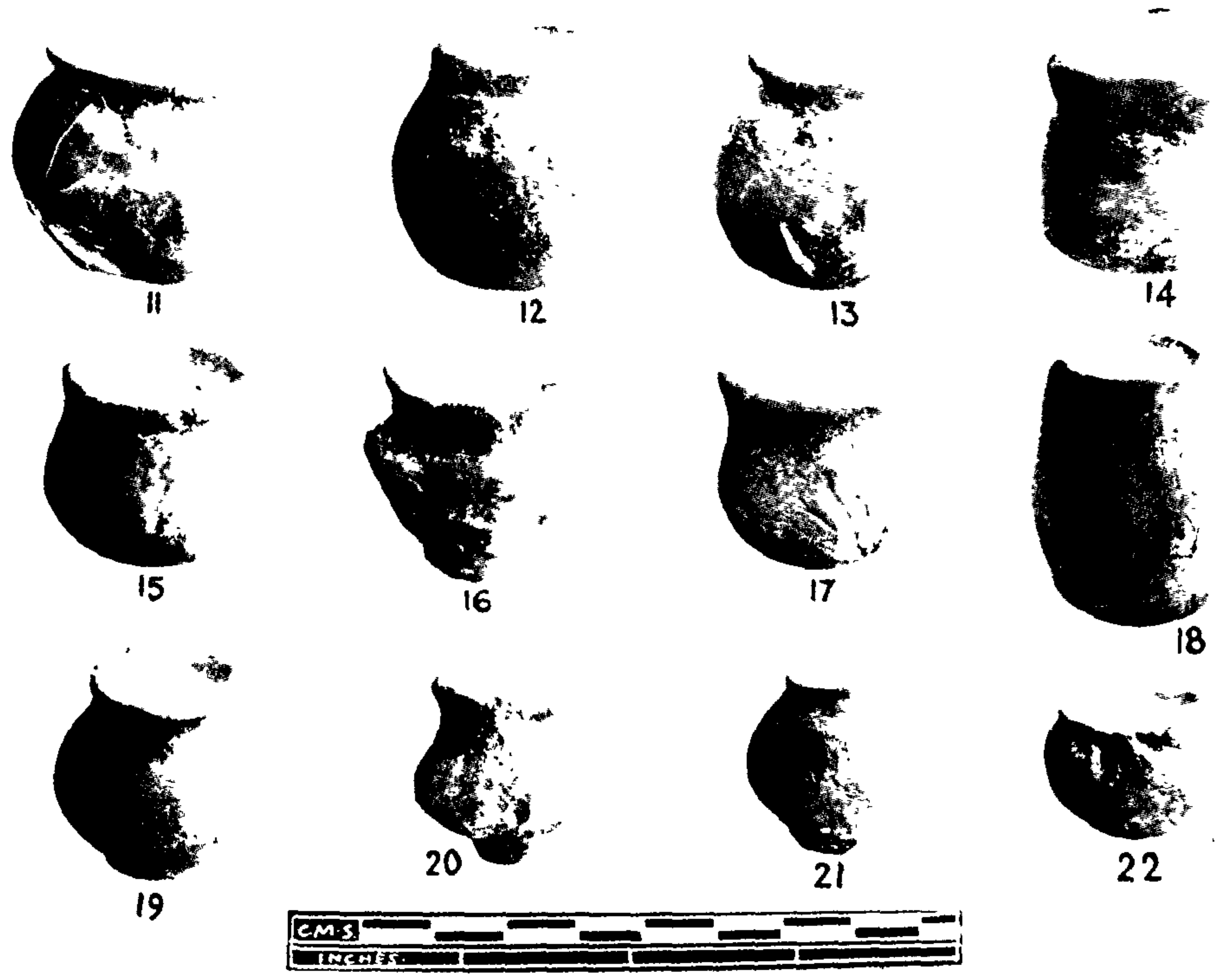
A. *Burial pottery 1-5 jars from Period A; 6 Lota-shaped vessel from Period B.* B. *Burial pottery. Dish-on-stand Period A:* C. *Burial pottery. 1 jar Period B: 2-5 bowls without handle: 6-7 bowls with stud-handle Period B.* *See p. 454*

A

B

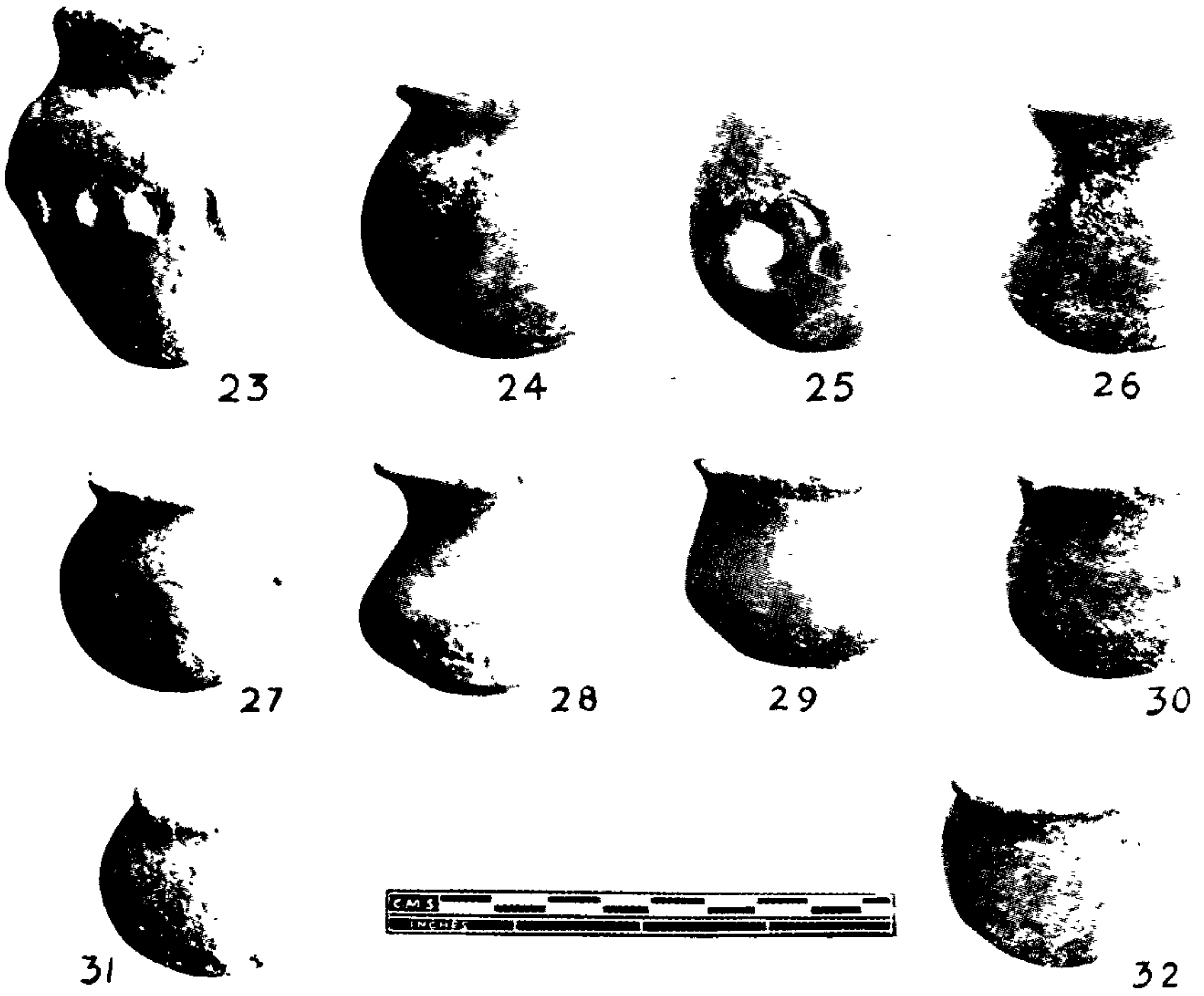
A. Pottery of foreign origin. 1-10 Reserved slip Ware; 11-14 other painted wares of Mesopotamian origin; 15-16 Prabhas Ware; 17-19 Miscellaneous; B. Bowl with a stud-handle in Micaceous Red Ware from Lothal Period A. See pp. 432, 454 and 455

A

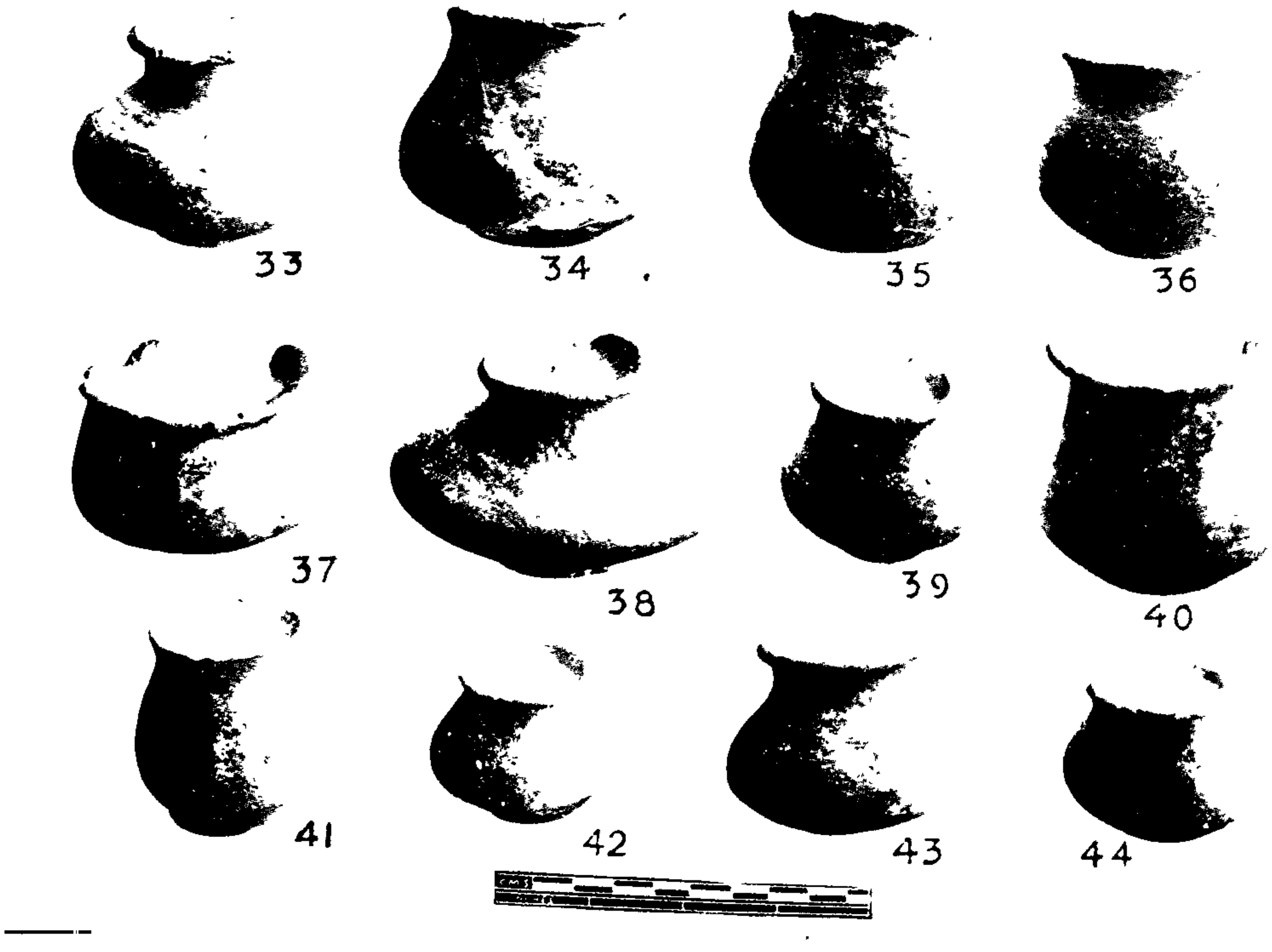


B

A. *Miniature vessels in coarse handmade ware*, 1-7 *and* 9 *jars*; 8 *trough*; 10 *bowl*; B. *Miniature vessels in coarse handmade ware*, 11-15 *and* 18-22 *jars*; 16 *cup*; 17 *basin*. *See pp.* 456 *and* 457

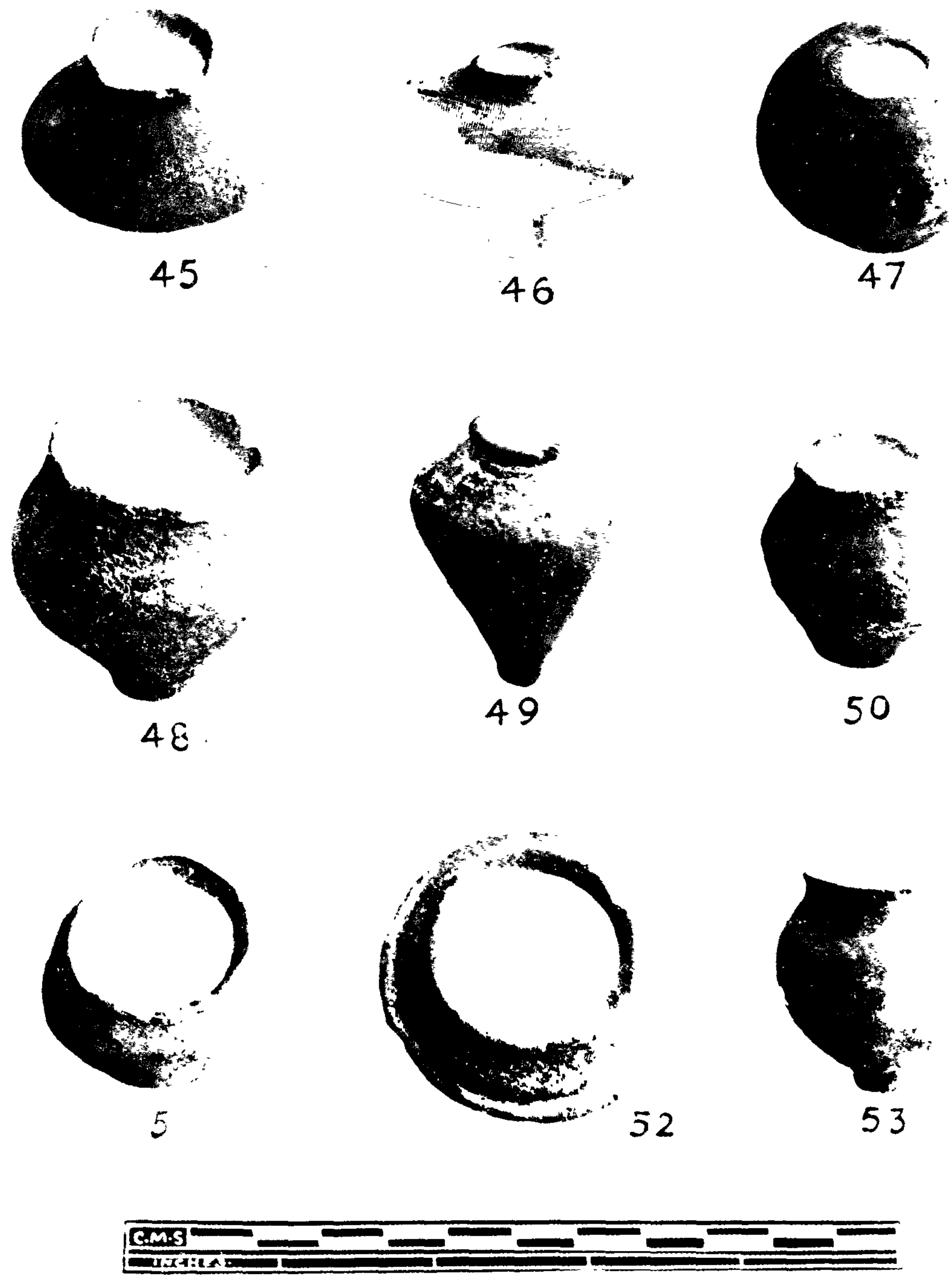


A

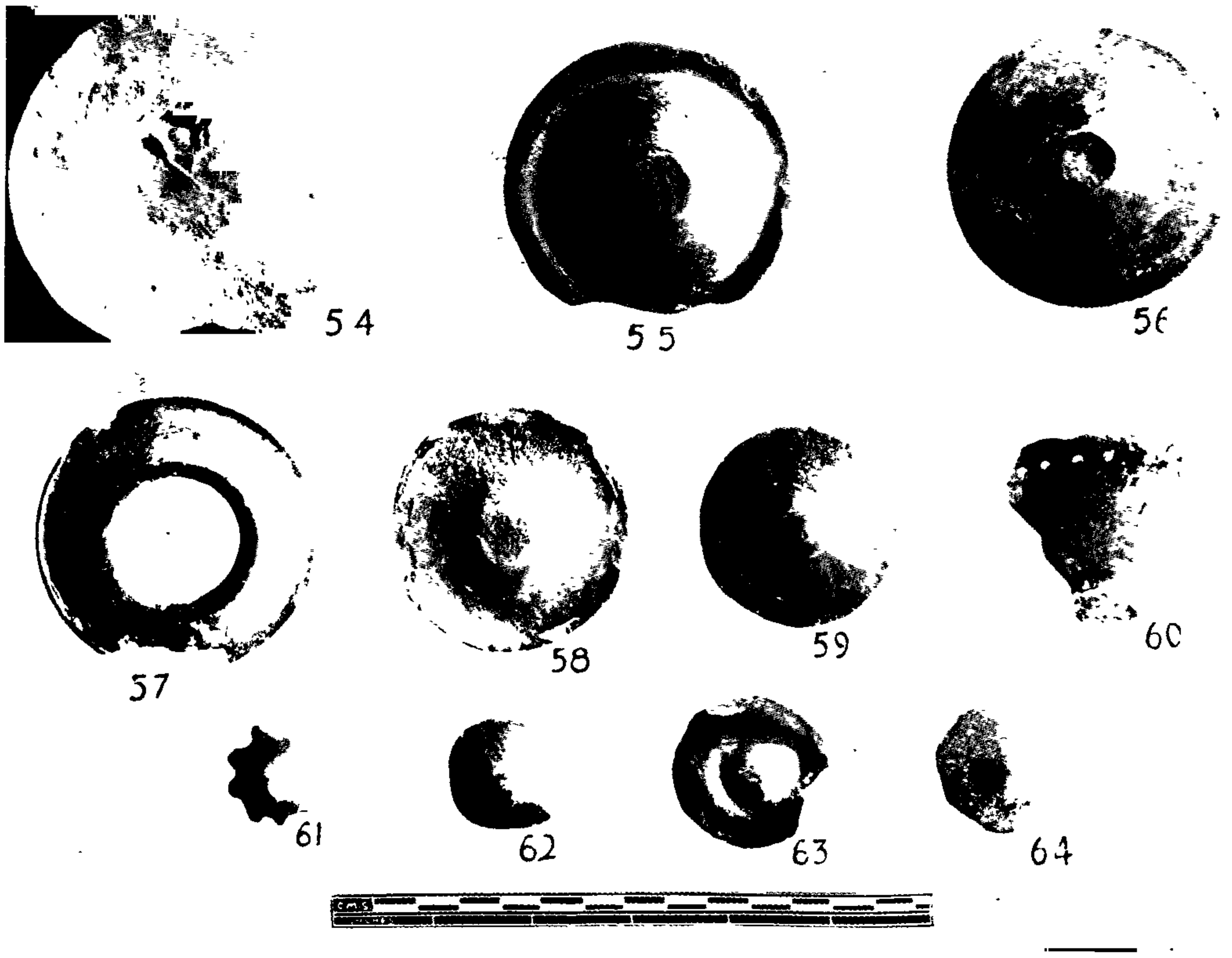


B

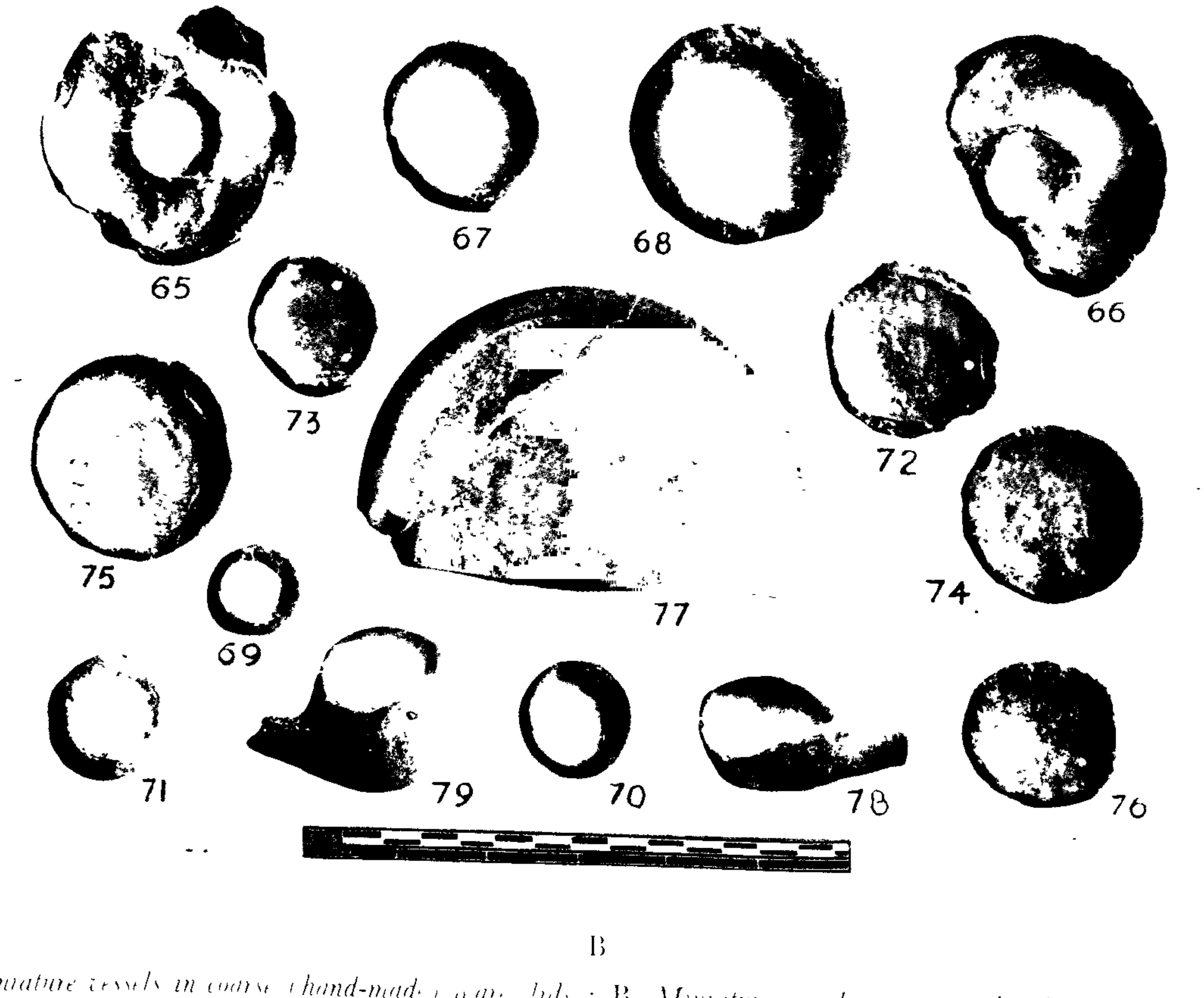
A. *Miniature vessels in coarse (handmade) ware, 23-32 jars.* B. *Miniature vessels in sturdy ware, 33-34 and 36-44 jars; 35 S-shaped vessels; 37 basin.* *See p. 457*



Miniature vessels in sturdy ware. 45-48 and 50-53 jars; 49 goblet. *See p.* 457



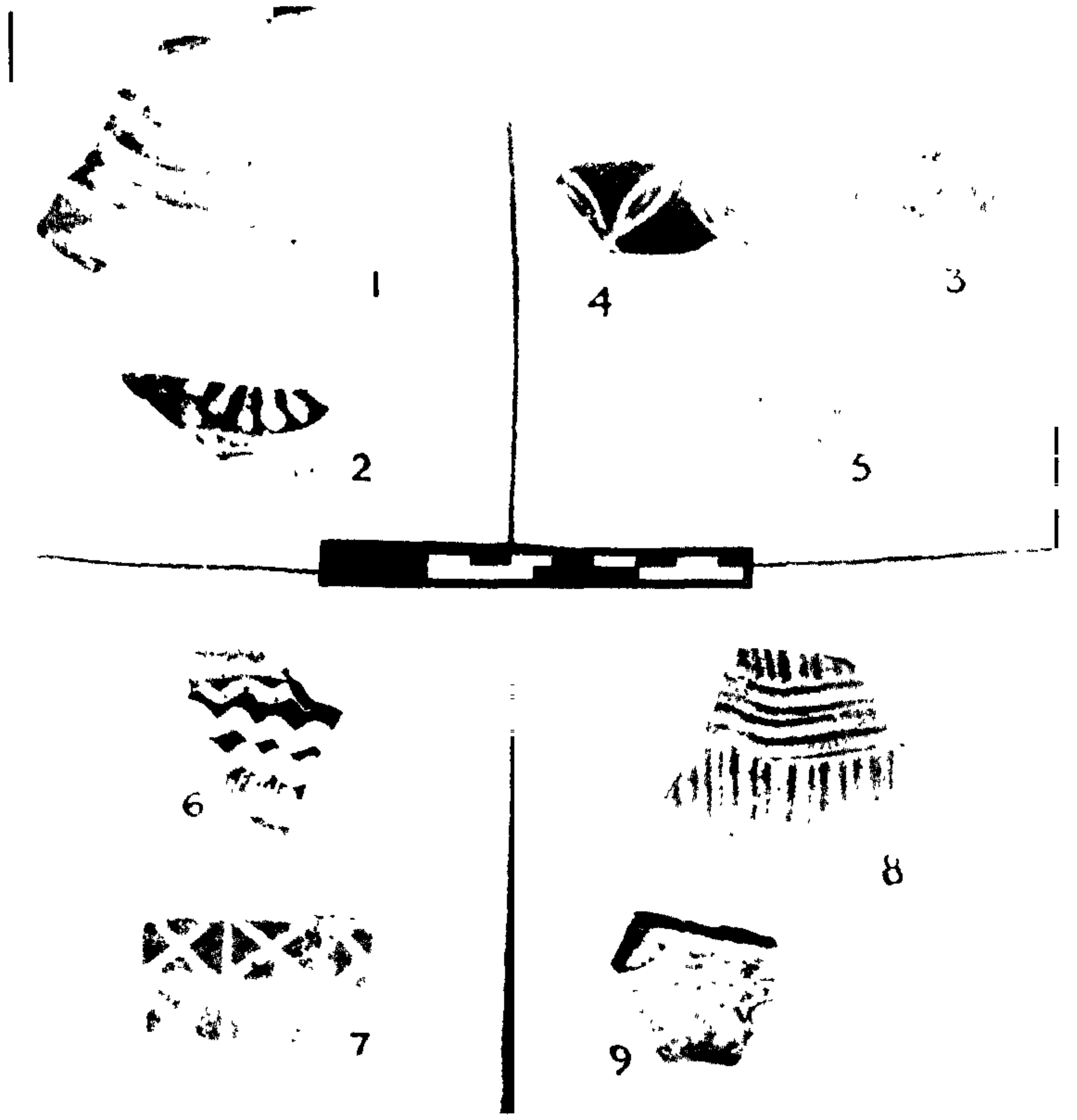
A



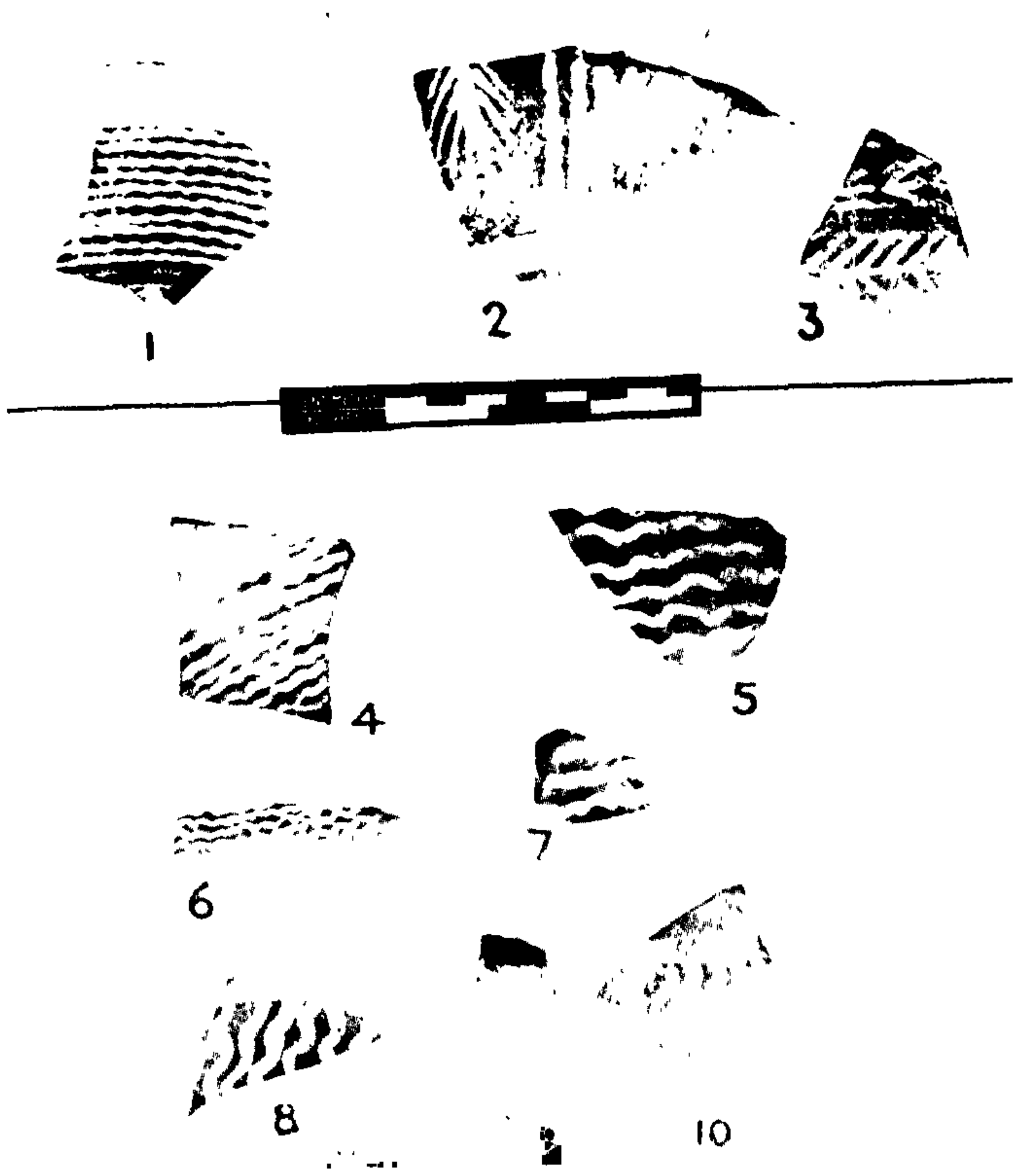
B

A. *Miniature vessels in coarse hand-made ware, lids*; B. *Miniature vessels in coarse handmade ware, 65-66 lids, 67-71 bowls; 72-73 scale-pans; 74-76 dough plates; 77 dish; 78-79 feeding vessels.* *See p. 157*

Stag painted in pictorial style. Lothal Period A. See p. 107



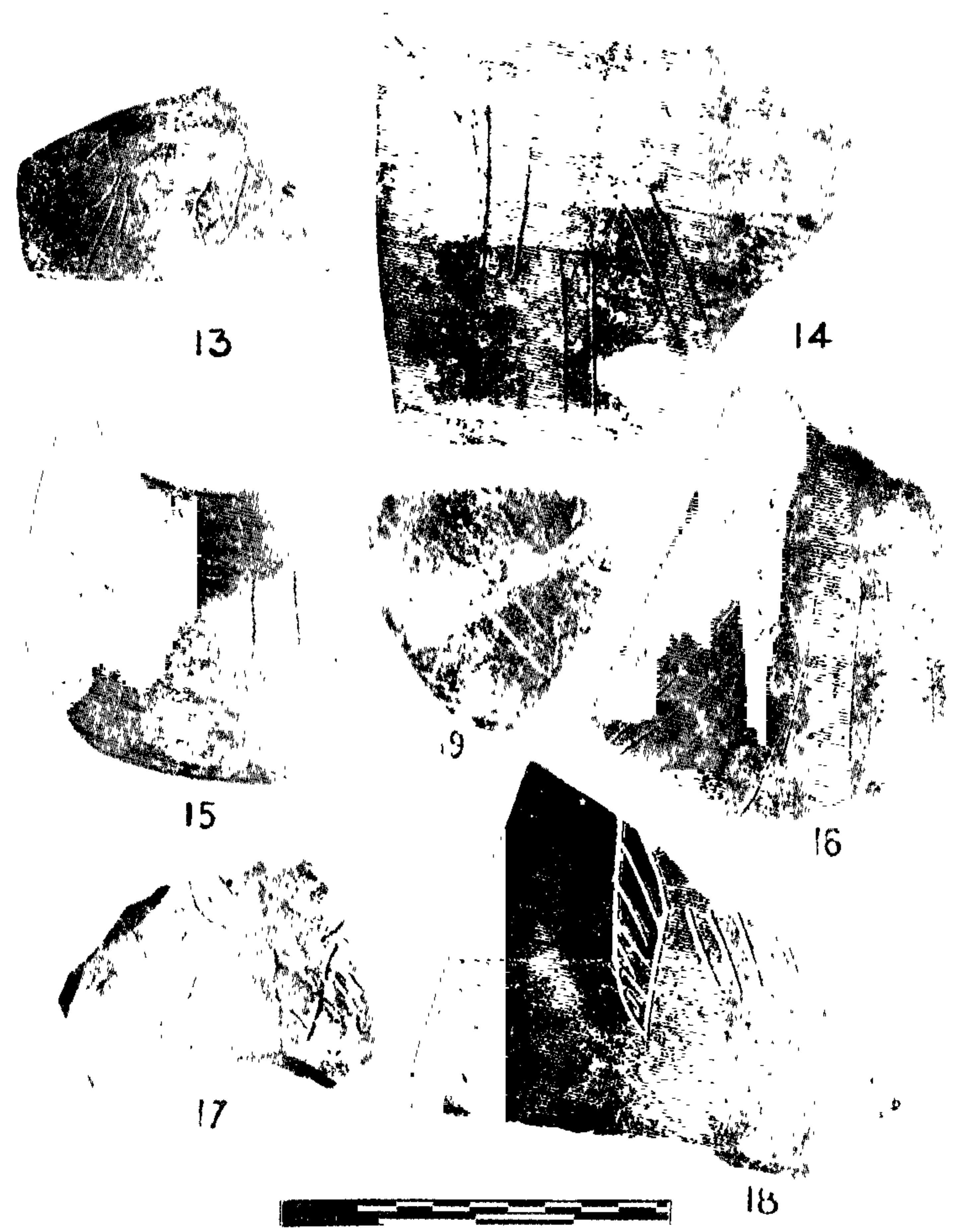
A



B

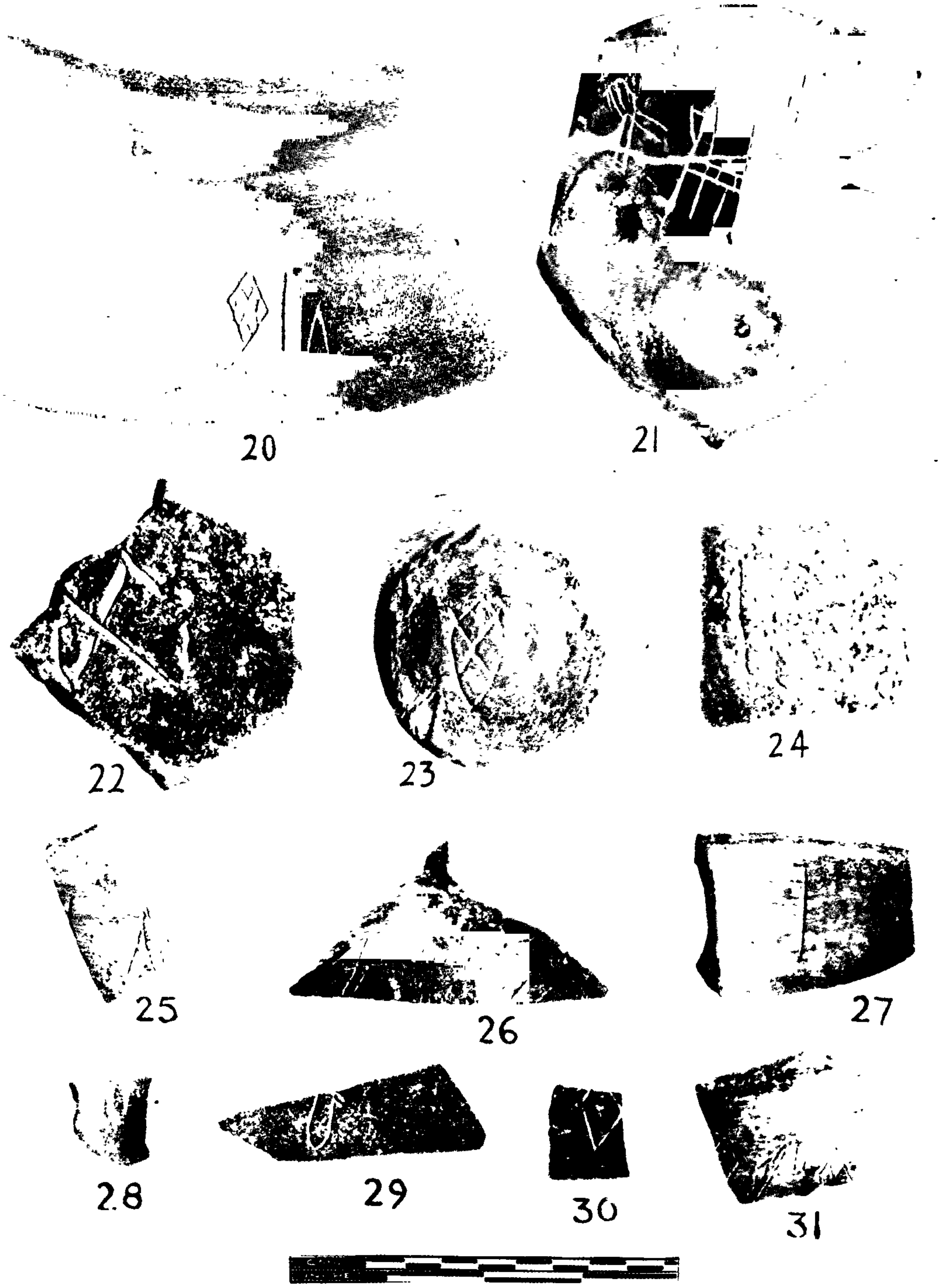
A, *Painted pottery from Brak, 1-7 Late Halaf; 8-9 Sargonid level (Reserved Ship Ware)*; B, *Painted pottery from Arpachiya (Halaf level?).*
See p. 454

A



B

A and B Graffiti Period A *See p* 158



Graffiti Period A. *See p.* 458

33

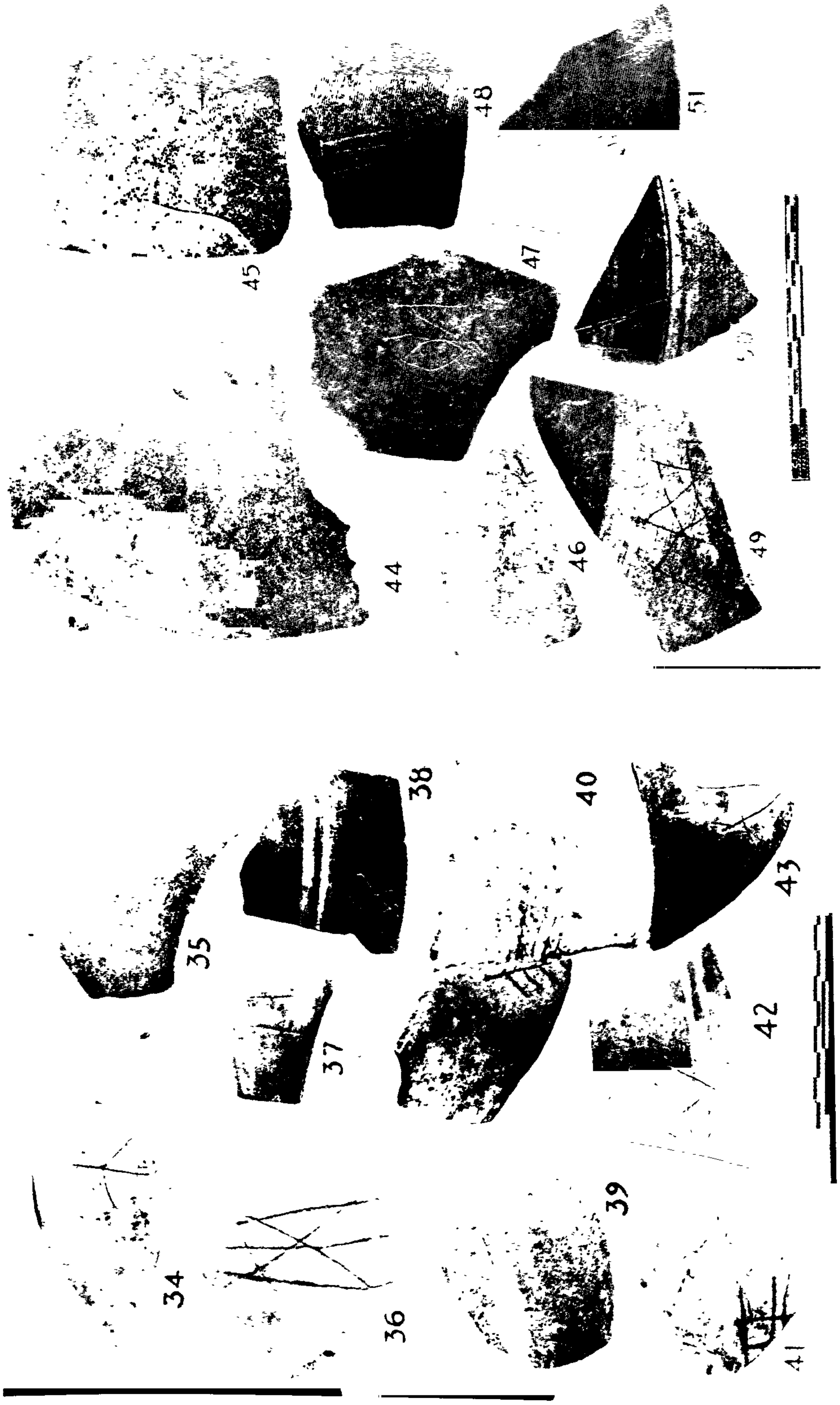
A

32

B

A. *Graffiti Period A. Scale 2/1*; B. *Graffiti Period B* *See p.* 460

PLATE CXCIV



A B

A and B *Graffiti Period B.* *See p 460*

A

C

B

D

A. *Terracotta head with Sumerian features Period A. Scale 5:2.* B. *Torso of a male figure.* C. *Male figure with a horse-head Period A. Scale 3:1.* D. *Terracotta model of a mummy Period A. Scale 3:2.* *See p. 478*

A

B

C

A, *Torso of a male figure (terracotta) Period A, Scale 3/1*; B, *Upper part of a female figure (terracotta) Period A, Scale 3/1*; C, *Upper half of a male figure (terracotta) Period A, Scale 3/1*. *See p. 478* and *480*

A

B

C

D

A-D, *Terracotta figures.* A, *Torso of a female figure Period A, Scale 2/1;* B, *Headless female figure Period A, Scale 3/1;* C, *Torso of a female figure Period A, Scale 3/1;* D, *A female figure with a pedestal base; Mother Goddess (?) Period A, Scale 1/1.* *See pp. 177* and *180*

A

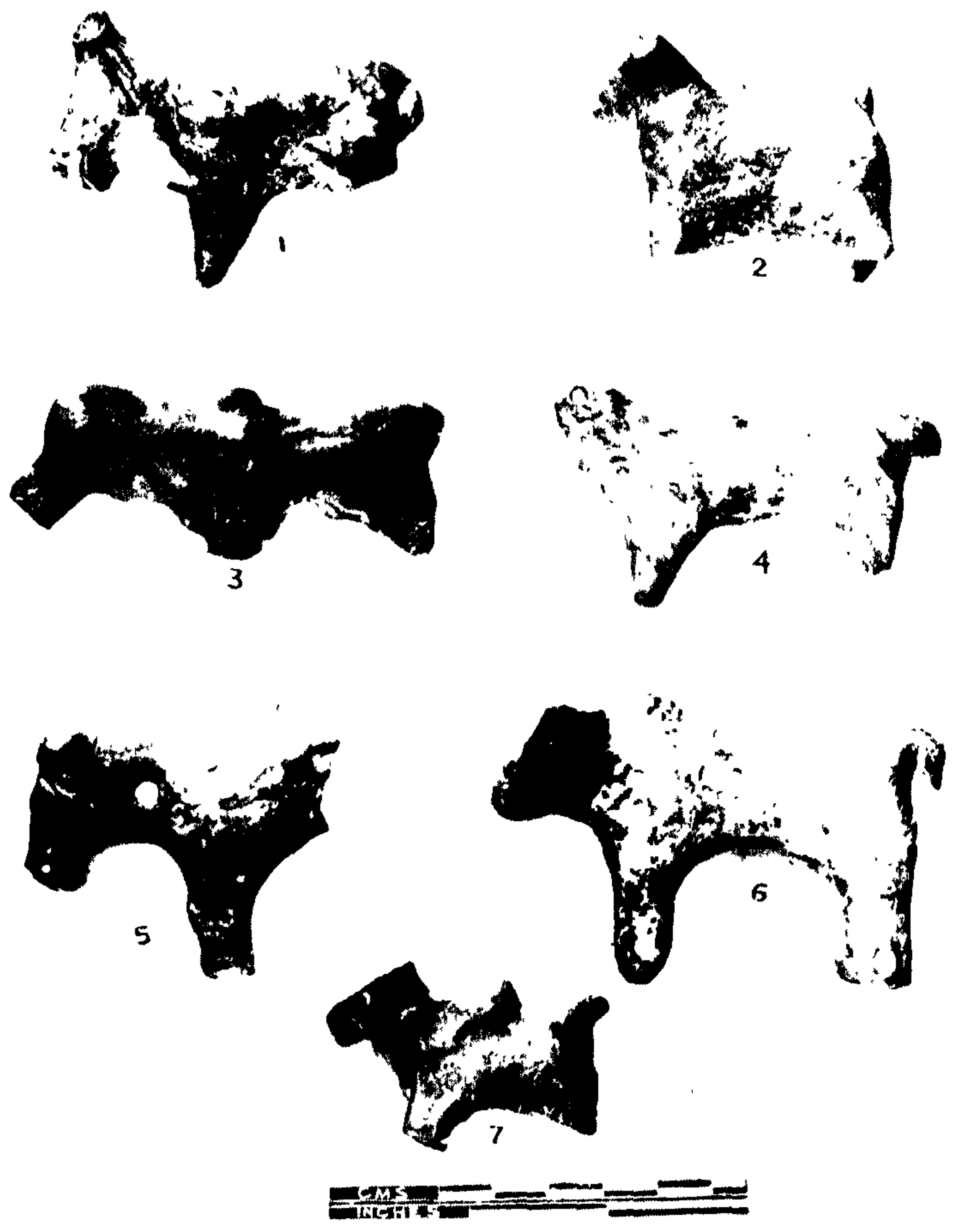
B

C

A-C, *Terracotta figures*. A, *Gorilla Period A. Scale 3/1*; B, *Model of a human leg Period A. Scale 5/6*, C, *Humped bulls*.
See pp 480 and 487

A

B

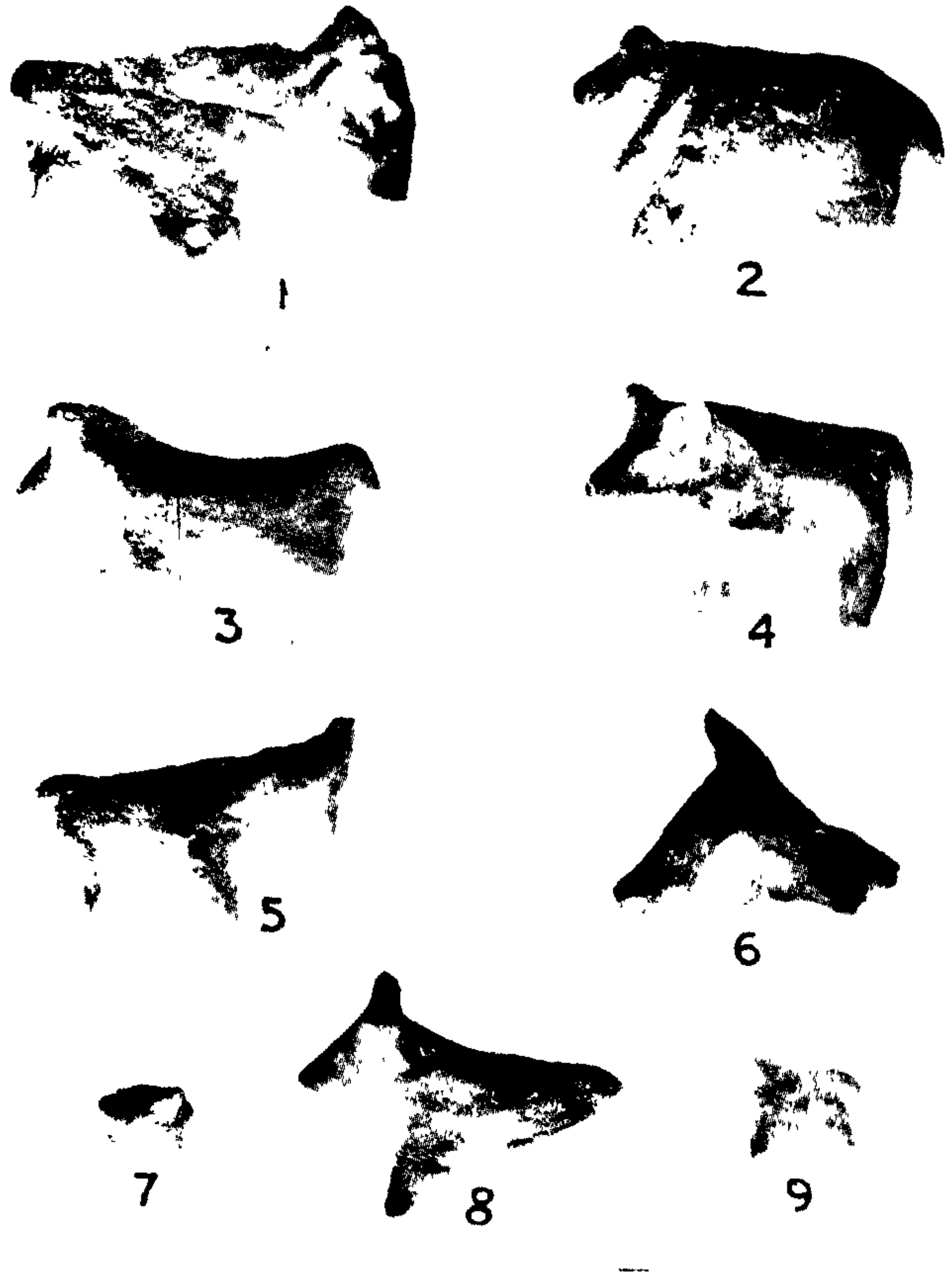


C

A-C. *Terracotta figures.* A. *Humped bull of Kulli type Period A. Scale 3:1;* B. *Bull with a large hump and dewlap Period A. Scale 3:1;* C. *Bulls with low hump. All except 2 from Period A. 2 Period B. See pp. 187 and 189*

A

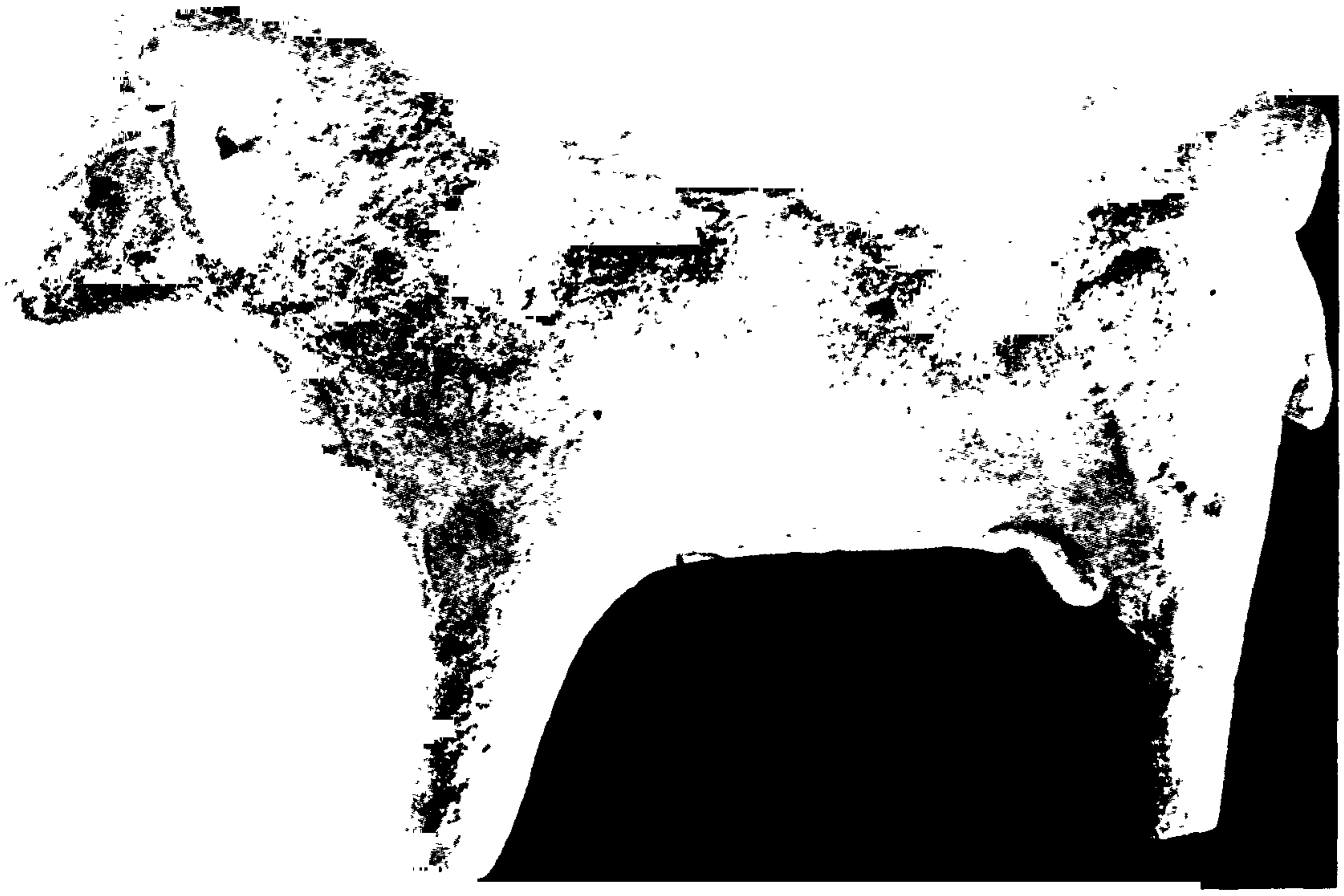
B



C

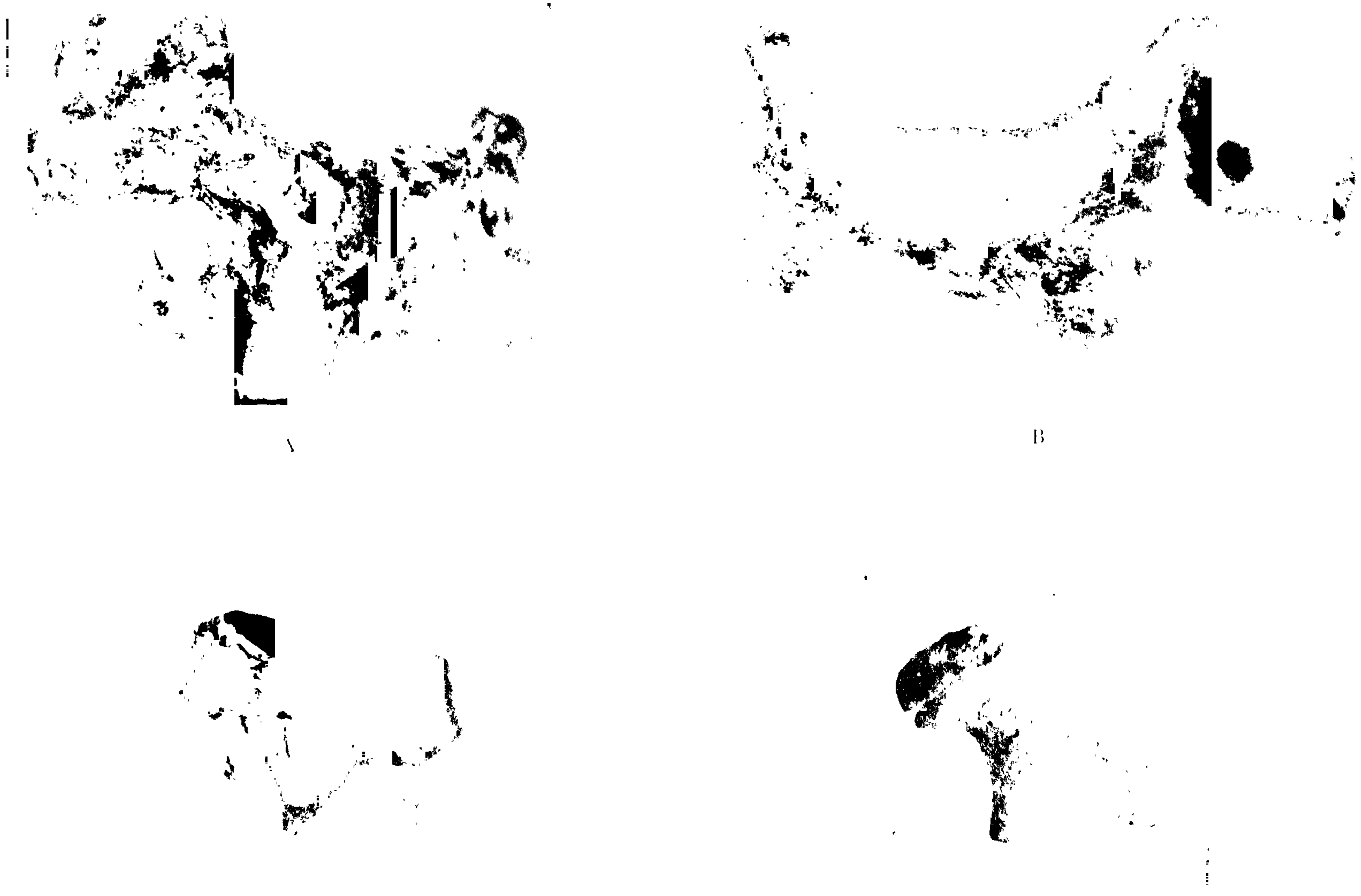
A-C, *Terracotta figures.* A, *Bull with elongated body, Scale* 1 : 1; B, *Bull with exaggerated hump and perforation through neck Period A, Scale* 1 : 1; C, *Humpless bulls Period A. See pp.* 489 *and* 490.

A



B

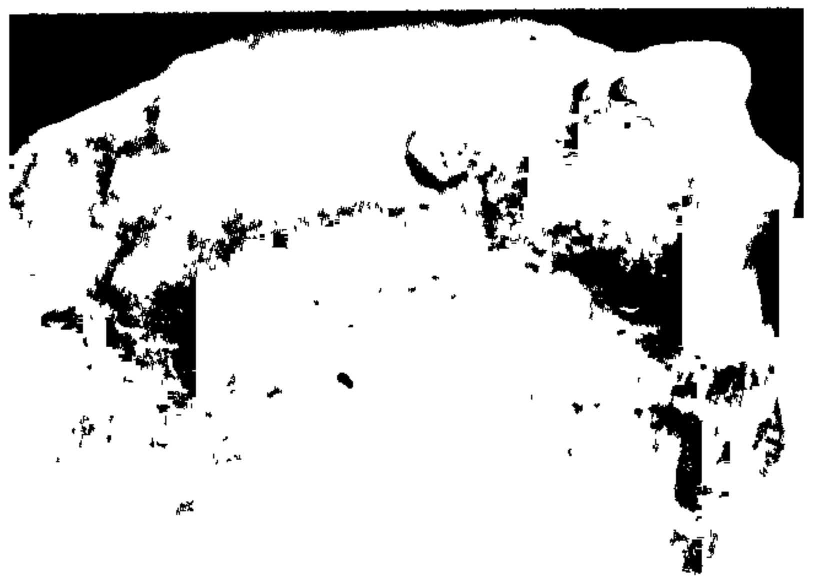
A and B. *Terracotta figure*. A, *Bull Period A. Scale 3:2*; B, *Goat Period A. Scale 3:1* See p. 490



A B C D

A-D. *Terracotta figures.* A, *Spotted dog Period A, Scale 1:1*; B, *Cat Period A, Scale 3:2*; C, *Mastiff Period A, Scale 3:2*; D, *Tiger Period A, Scale 1:2* *See pp. 482, 485, 490 and 491*

2



1

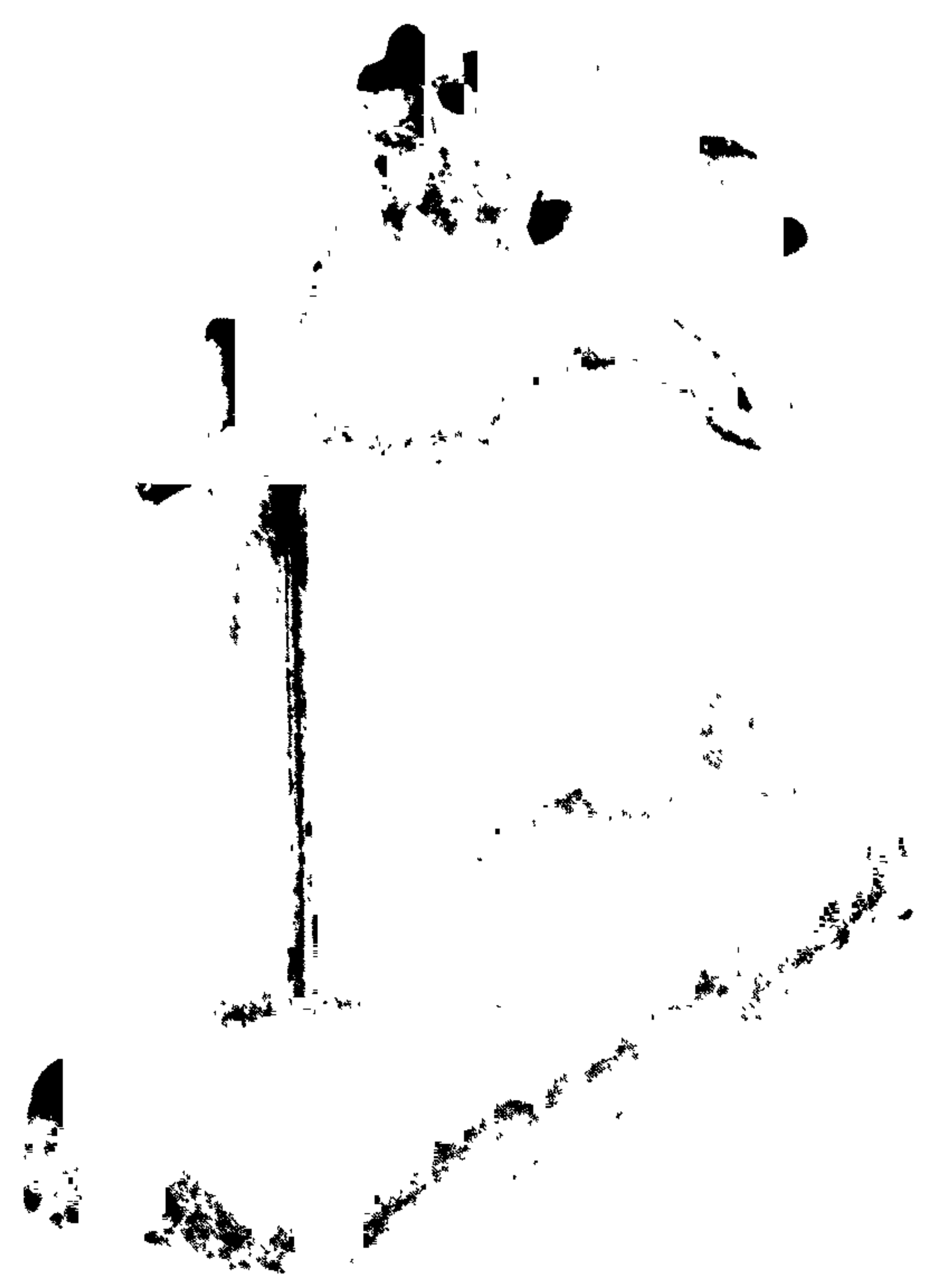
A

B

C

D

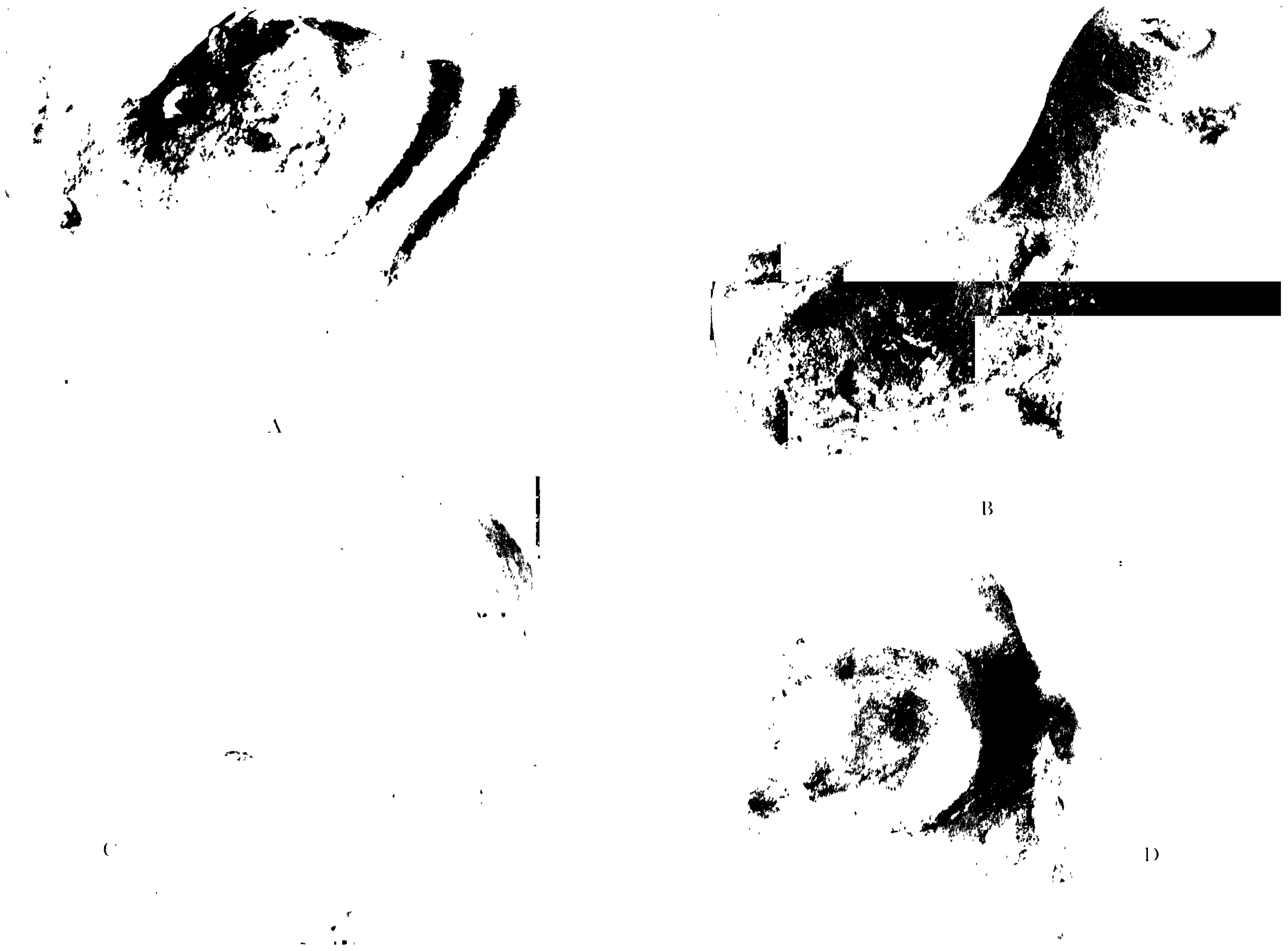
A-D. *Terracotta figures*. A. *Pigs*, *1 Period A*, *2 Period B*. *Scale 1:1*; B. *Leopard*, *Period A*, *Scale 3:1*; C. *Elephant*; *Period A*, *Scale 3:1*; D. *Rhinoceros*, *Period A*, *Scale 3:1*. *See pp. 182* and *192*



A

B

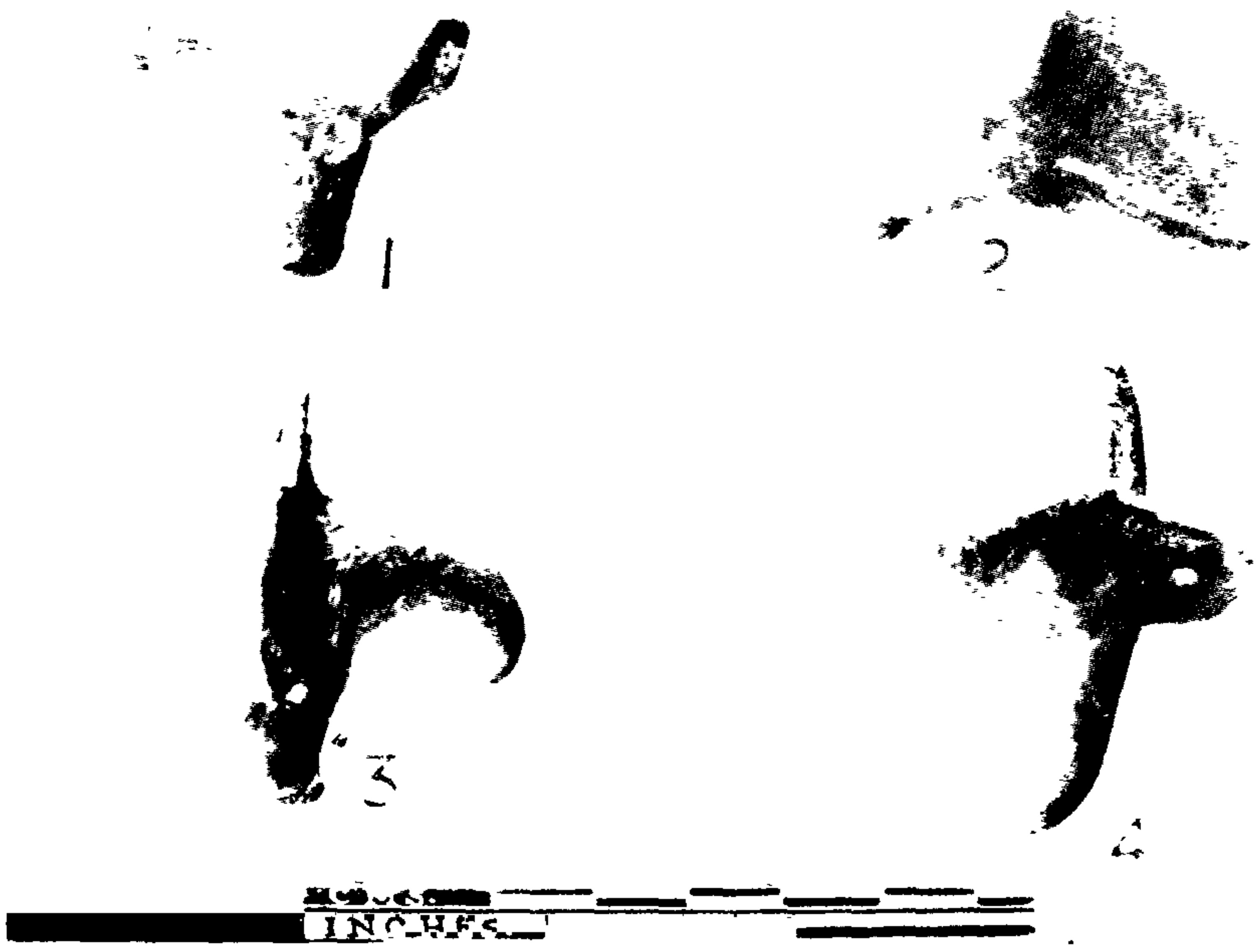
A and B. *Terracotta figures.* A, *Bear Period A, Scale 3/2; Mounted for demonstrating its use*; B, *Composite figure with human body and horse-head; Period A, Scale 2/1; Mounted for demonstrating its use.* *See p. 492*



A-D. *Terracotta figures* A. *Head of a rhinoceros Period A, Scale 2/1*; B. *Couchant ram Side view Period A, Scale 3/1*; C. *Couchant ram Front view Period A, Scale 3/1.* D. *Hollow head of a ram Period A, Scale 5/2.* *See pp* 181, 192, 193 and 495

PLATE CCVI

A-D. *Terracotta figures.* A. *Squatting squirrel. Period A. Scale 2/1;* B. *Horse. Period A. Scale 3/2;* C. *Head of a unicorn. Period A. Scale 2/3;* D. *Horse with a stumpy tail. Period A. Scale 2/1. See pp. 482, 483, 484, 493* and *494*

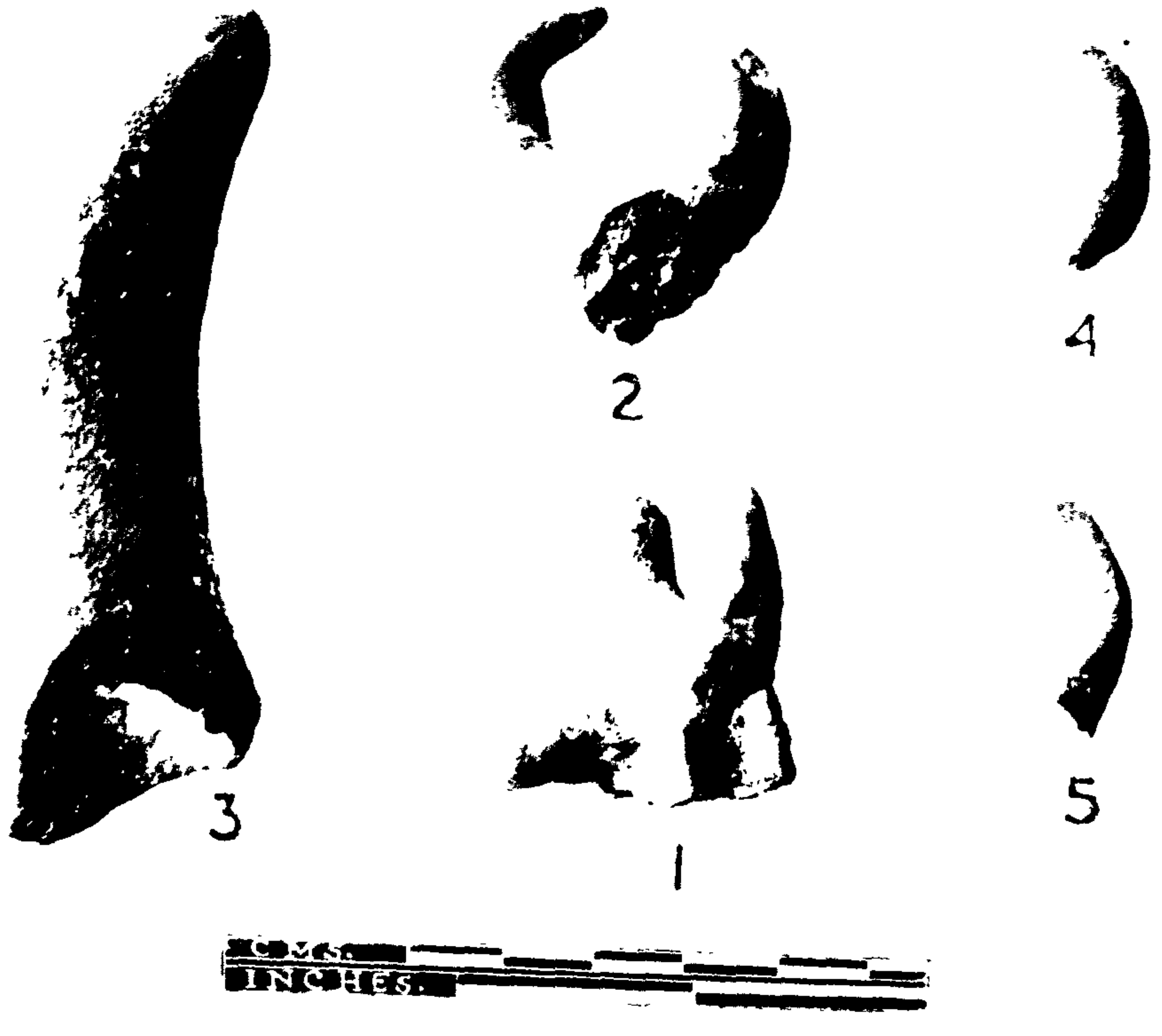


A

B

A. *Detached heads of animals (terracotta). Period A.* B. *Terracotta animal heads. Period A.* *See pp. 194 and 196*

A



B

A. *Terracotta birds Periods A and B*. B. *1-2 Terracotta animal heads, and 3-5 horns Period A*. *See p. 496*

A

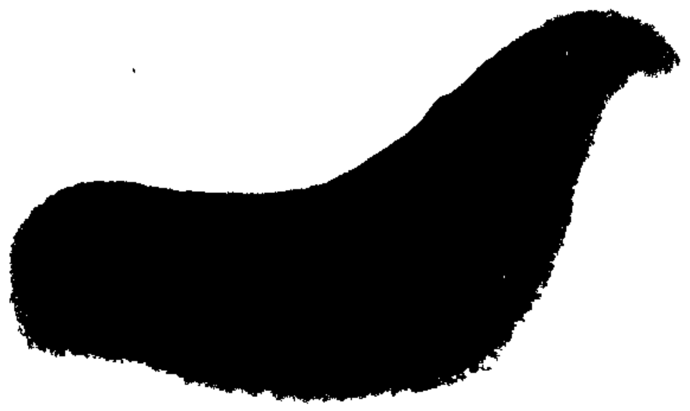
B

C

A-B. *Wheeled bull (terracotta) Period A, Scale 2:1.* C. *Terracotta bird Period A. Scale 2:1* *See pp. 186 and 197*

PLATE CCX

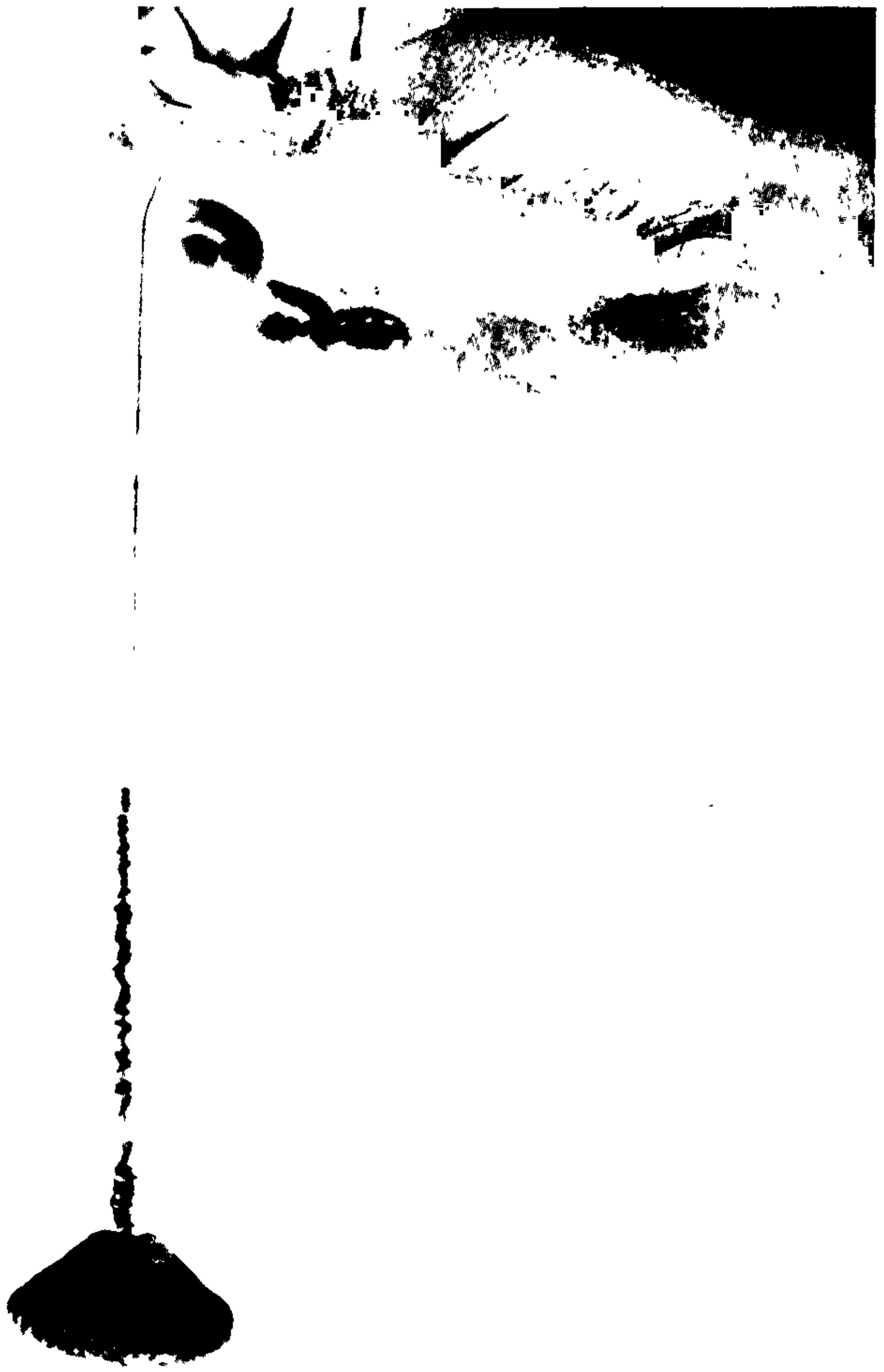
A



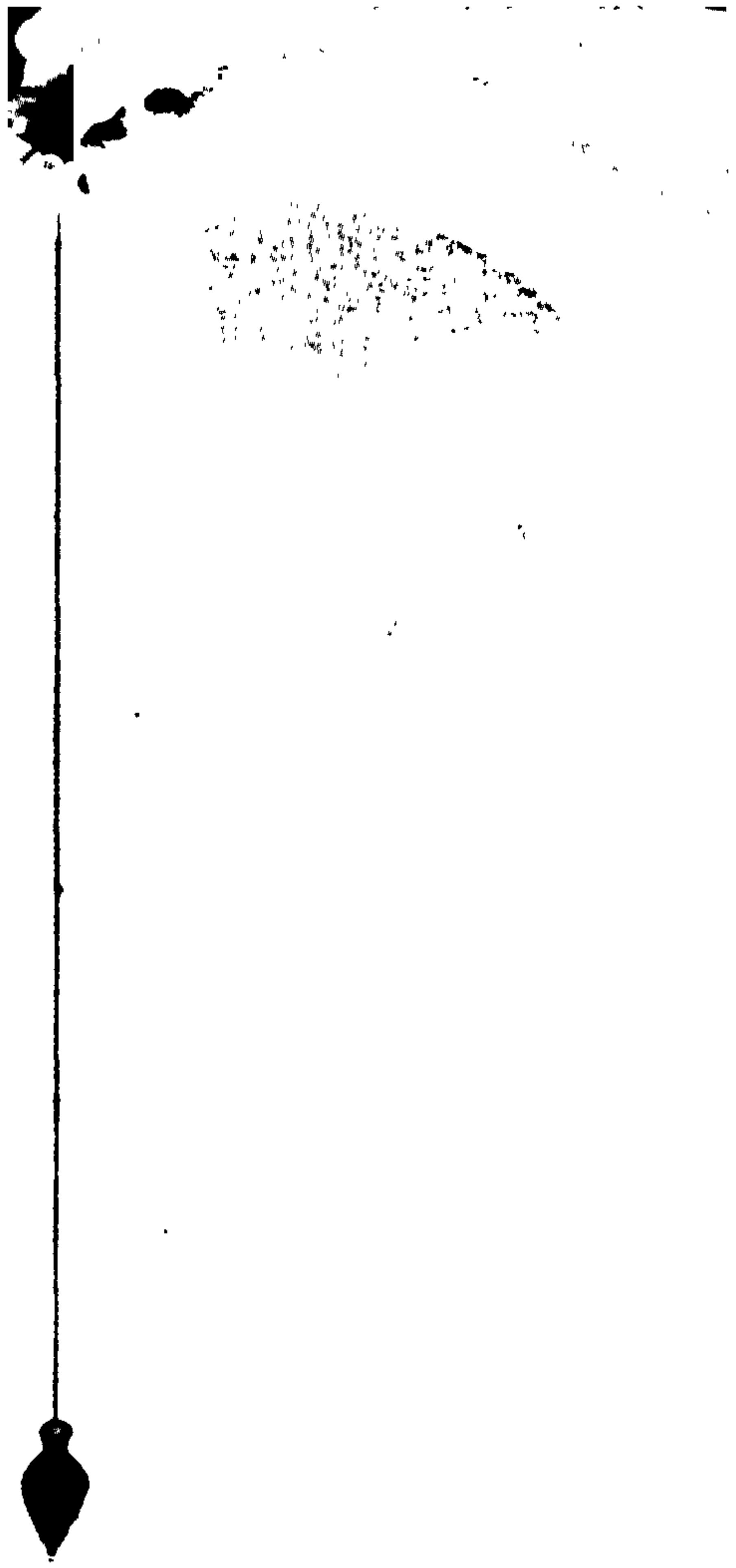
B

C

A. *Terracotta bird (wheeled) Period A. Scale 1:1.* B. *Terracotta bird (fixed on a spike) Period A. Scale 1:1.* C. *Terracotta and stone net-sinkers (used presently at Kaveripattinam). See pp. 197 and 198*

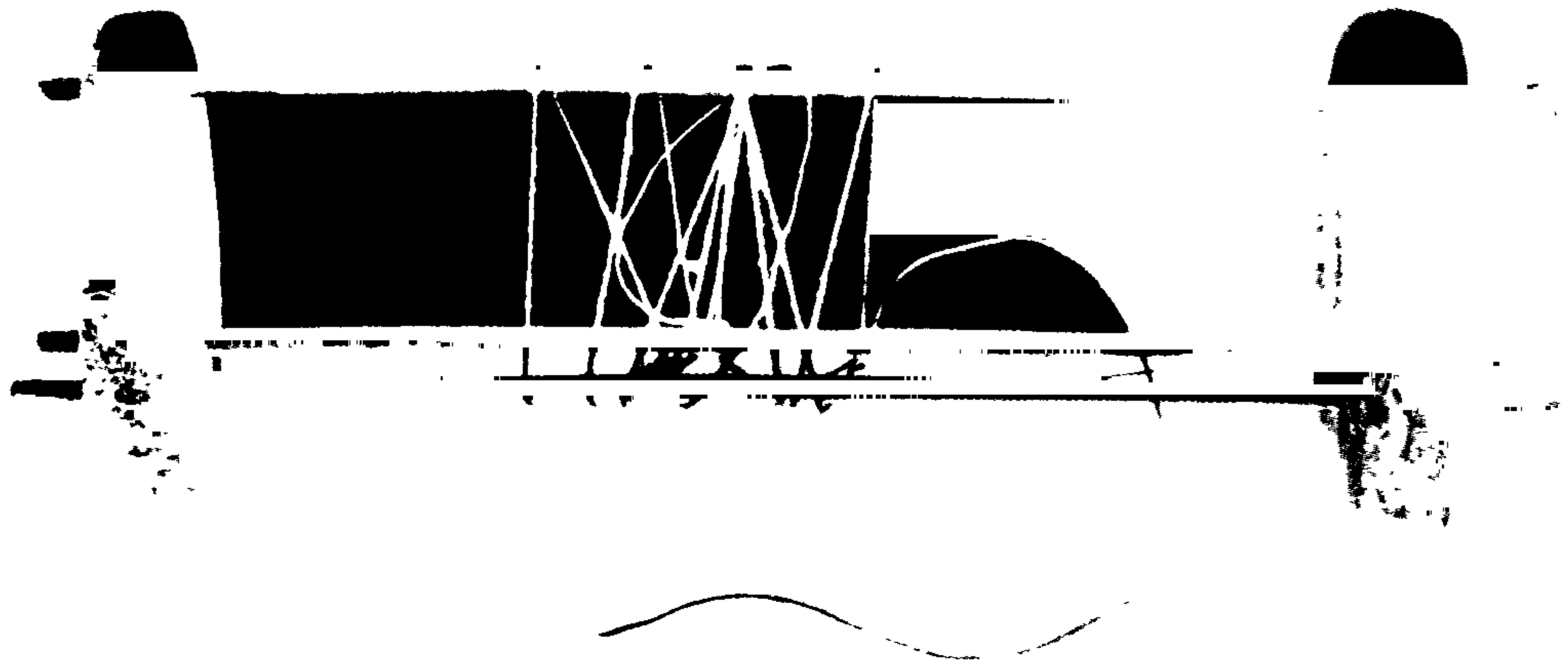


A



B

A. *Demonstrating use of a terracotta spindle whorl. Period I.* B. *Demonstrating use of a plumb bob (terracotta). Period I.* *See pp. 498 and 499.*

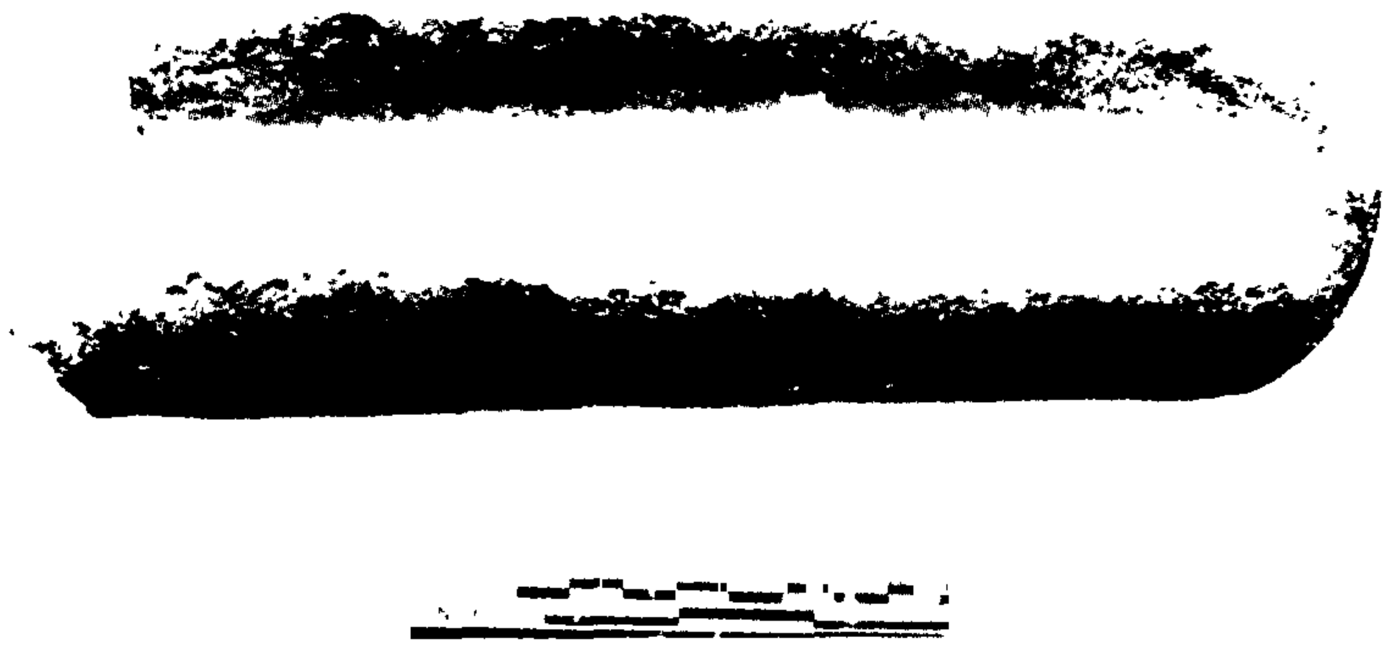


A

B

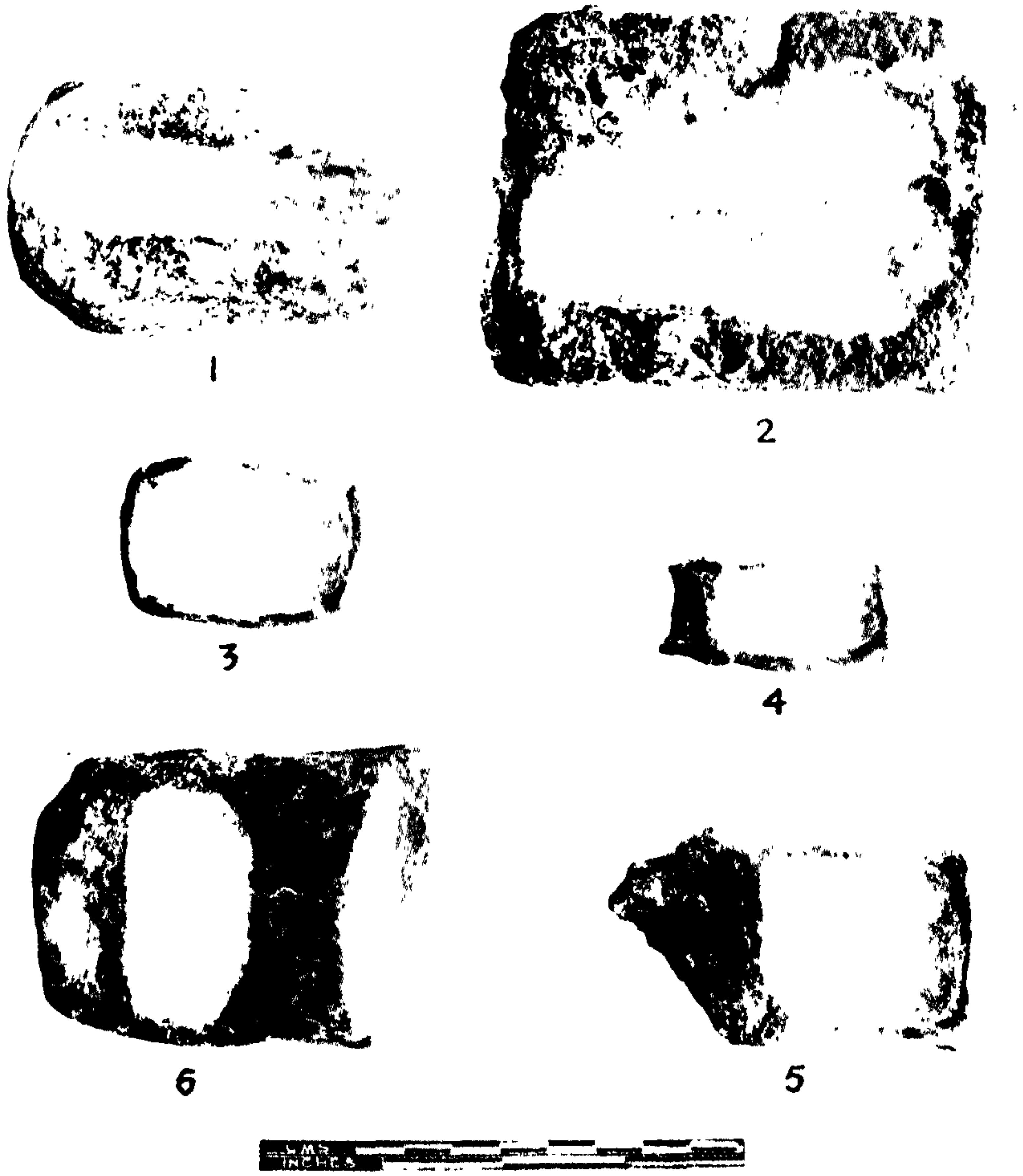
A. *Terracotta spools with three holes (wooden sticks and thread restored). Period A.* B. *Spools with six holes (wooden sticks and thread restored). Period A.* *See p. 498*

PLATE CCXIII



A

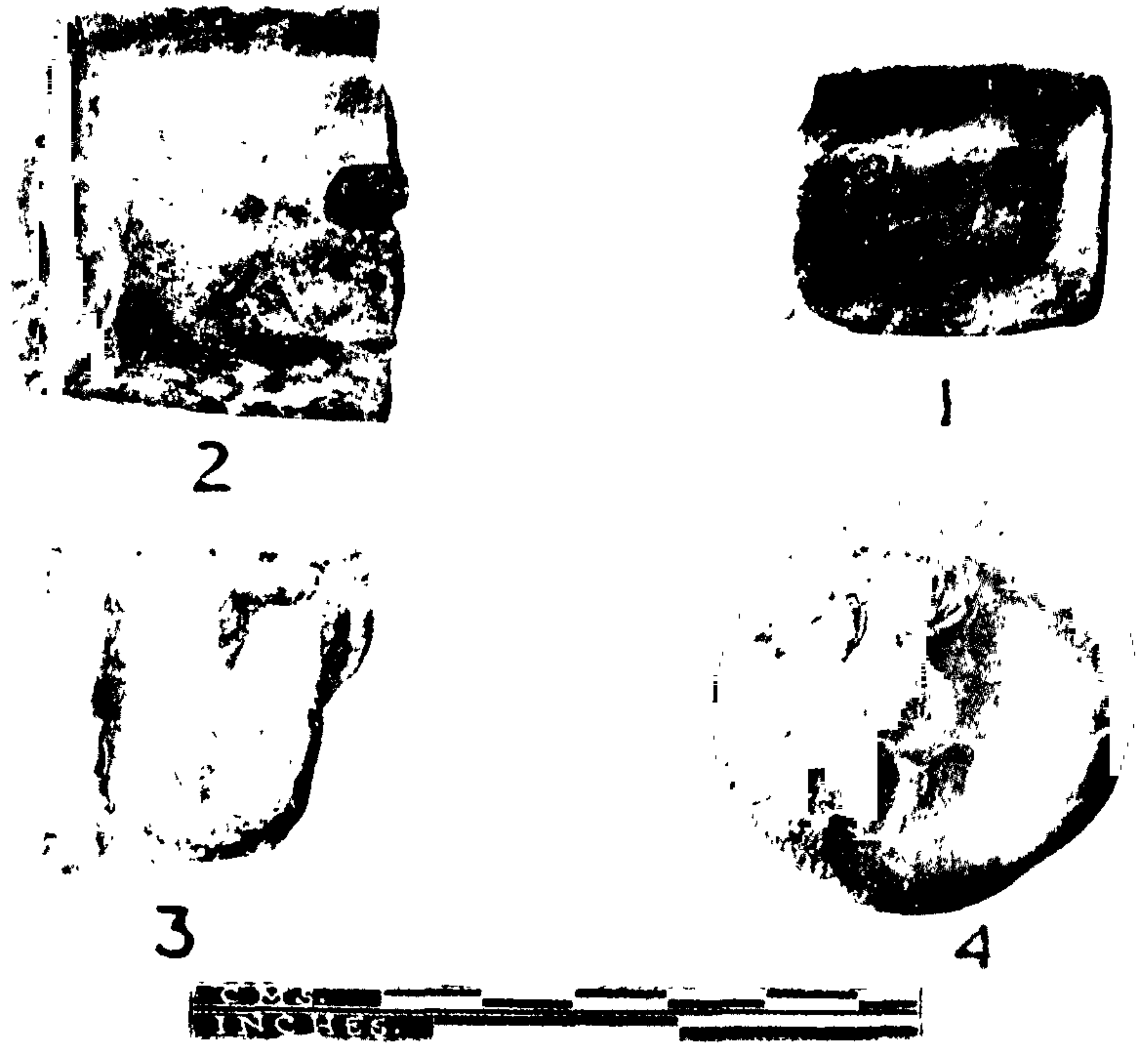
B



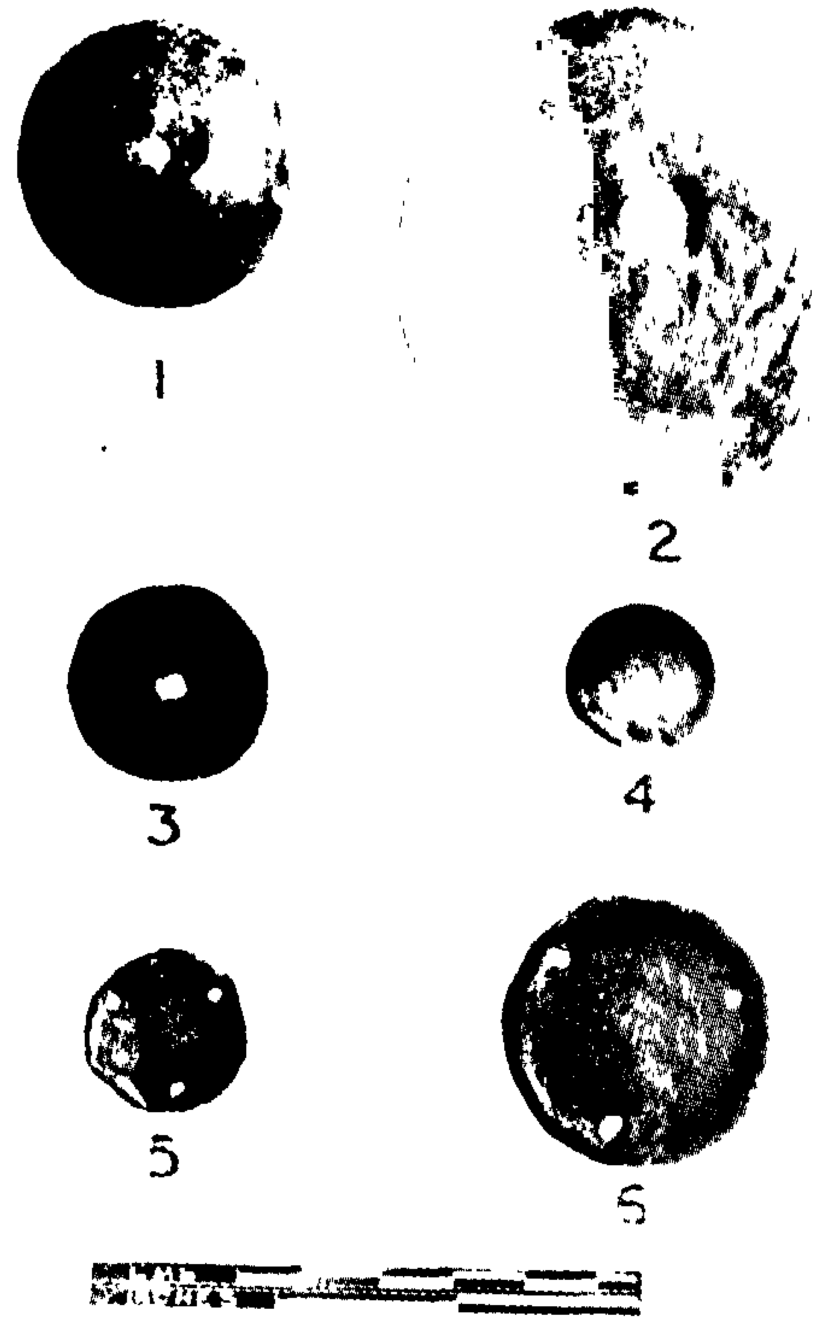
C

A-C, *Terracotta objects.* A, *Crucible from coppersmith's workshop, Period A*; B, *Spouted crucible, Period A*; C, *Crucibles and muffles, Period A*.

See p. 199

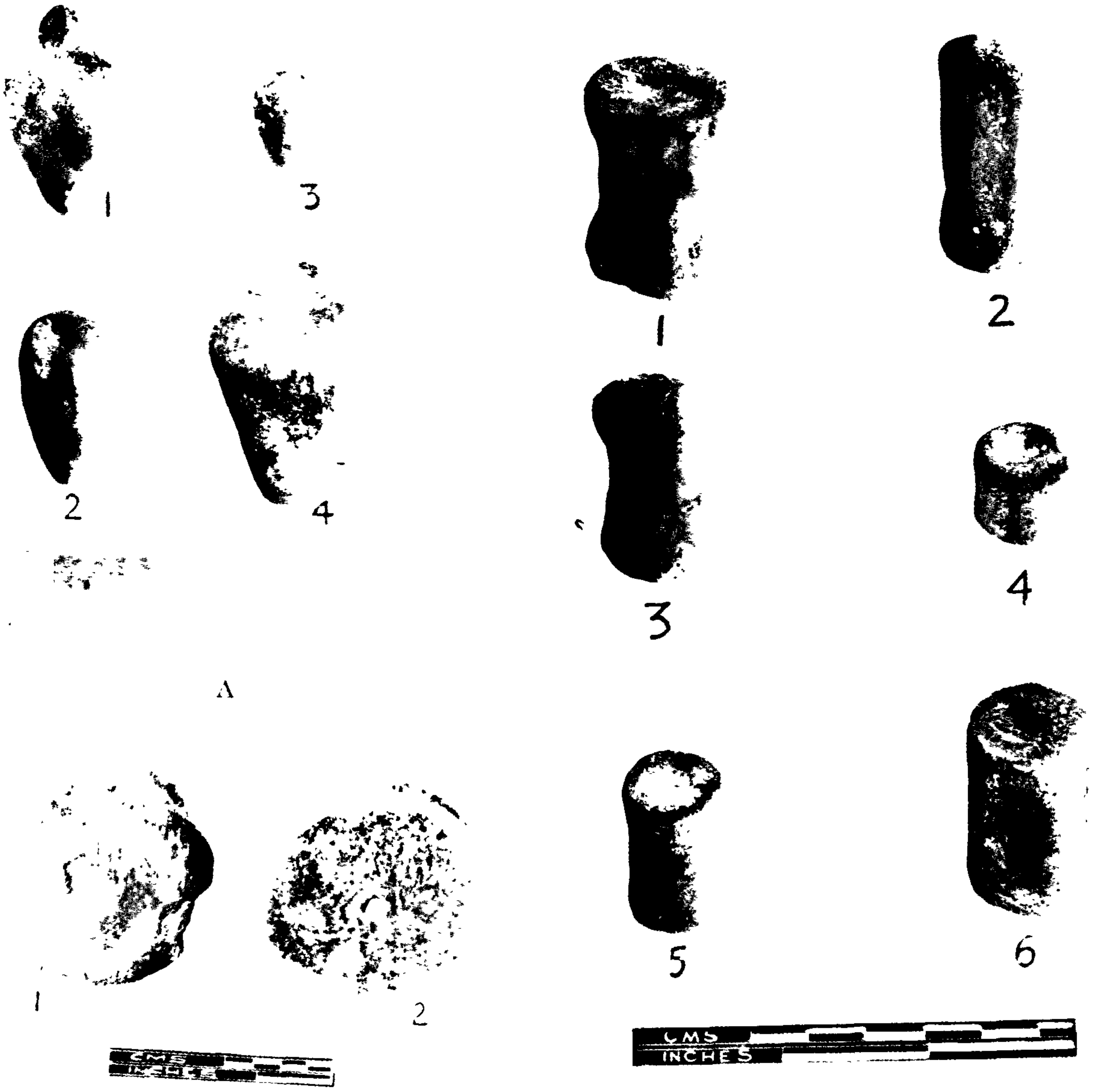


A



B

A. *Terracotta moulds and plaques Period A.* B. *Terracotta spindle whorls Period A.* *See pp.* 497 *and* 499



B C

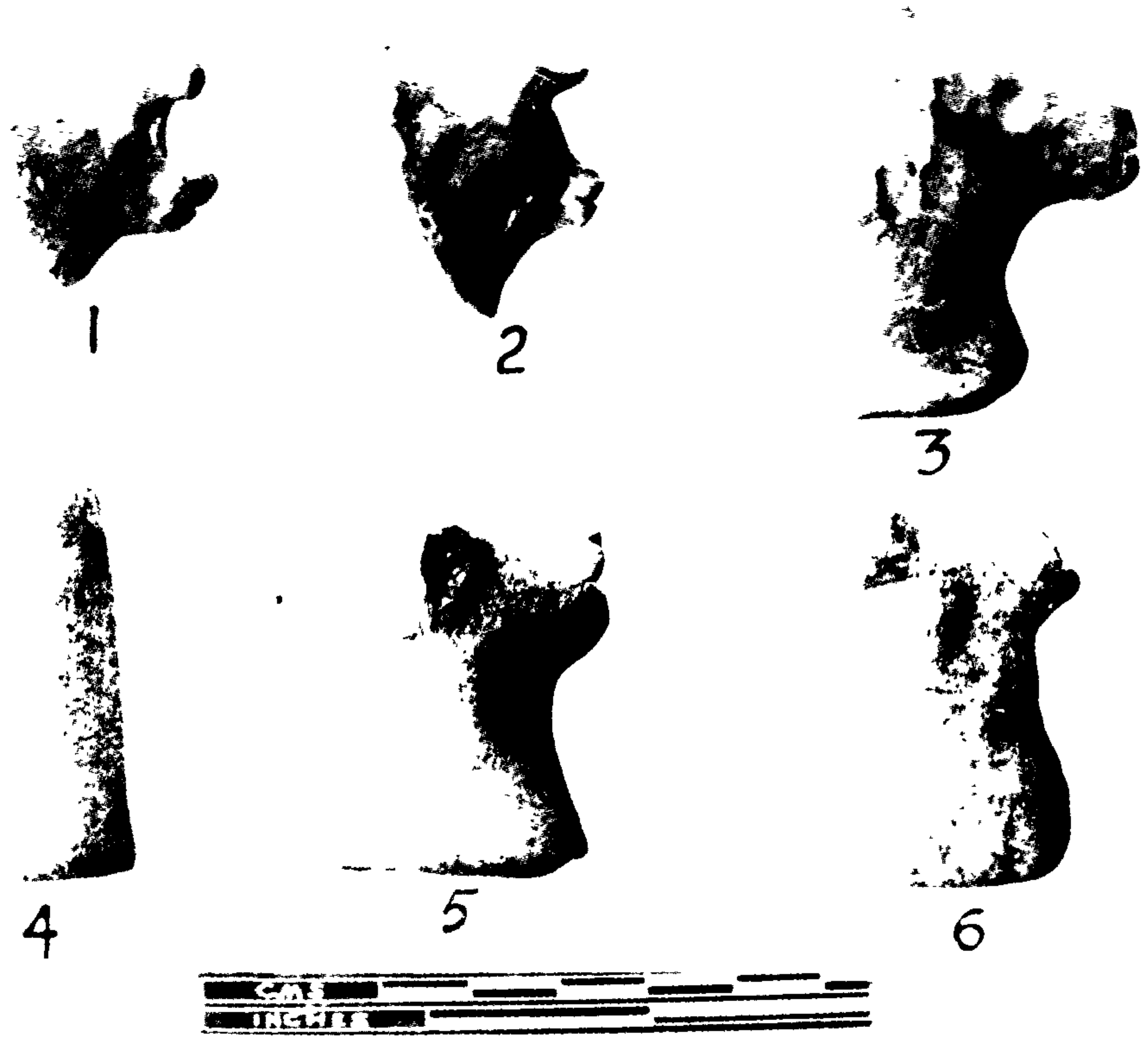
A-C, *Terracotta objects*. A, *Plumb bobs, Period I*; B, *Cylindrical [illegible], Period I*; C, *Cylindrical [illegible] weights, Periods I and B*. *See pp. 501*

A

B

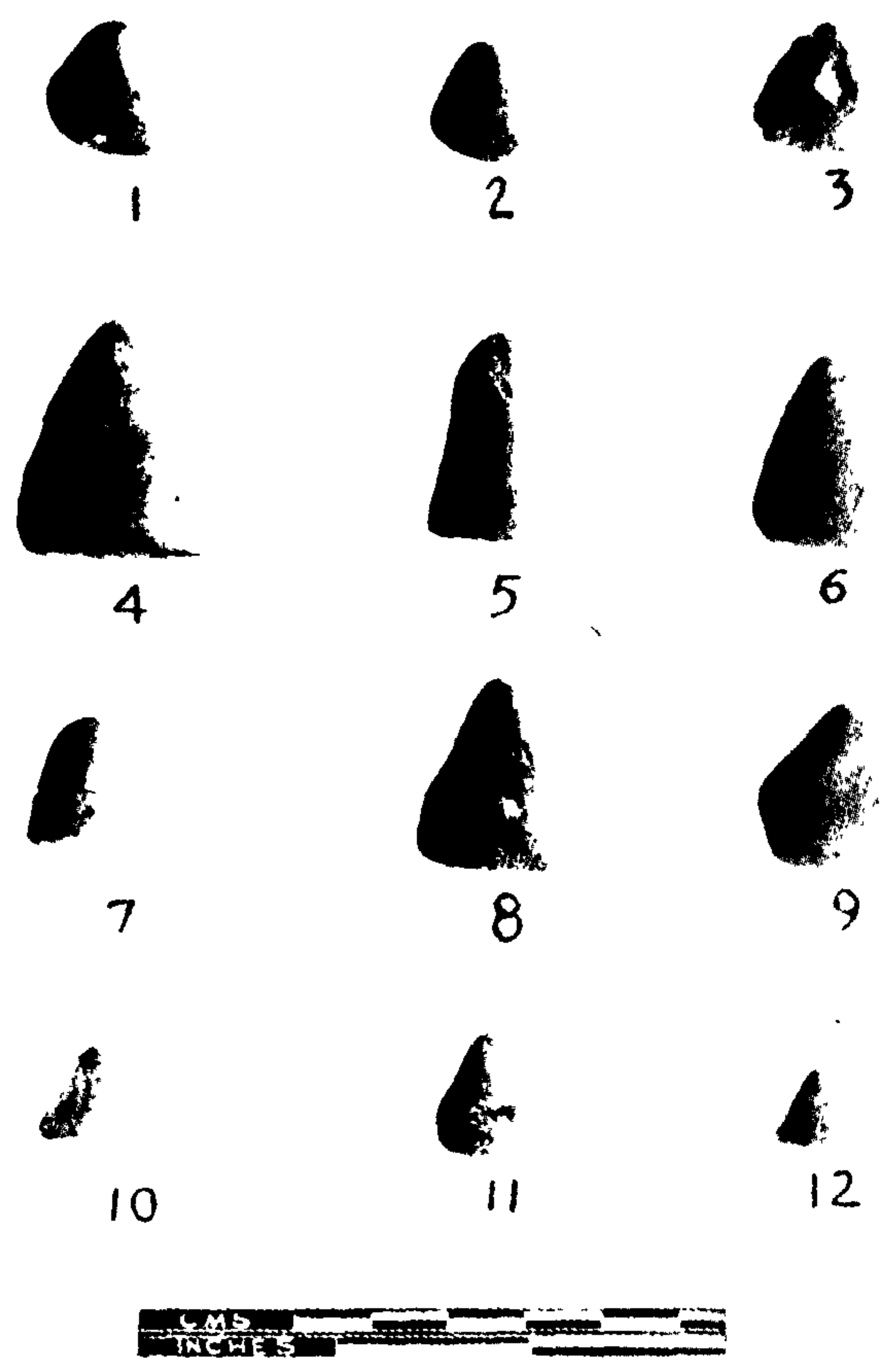
A. *Conical loom-weight (brick) Period A* ; B. *Terracotta spools from Lothal used in a modern charkha* *See pp. 198, 501 and 502*

A

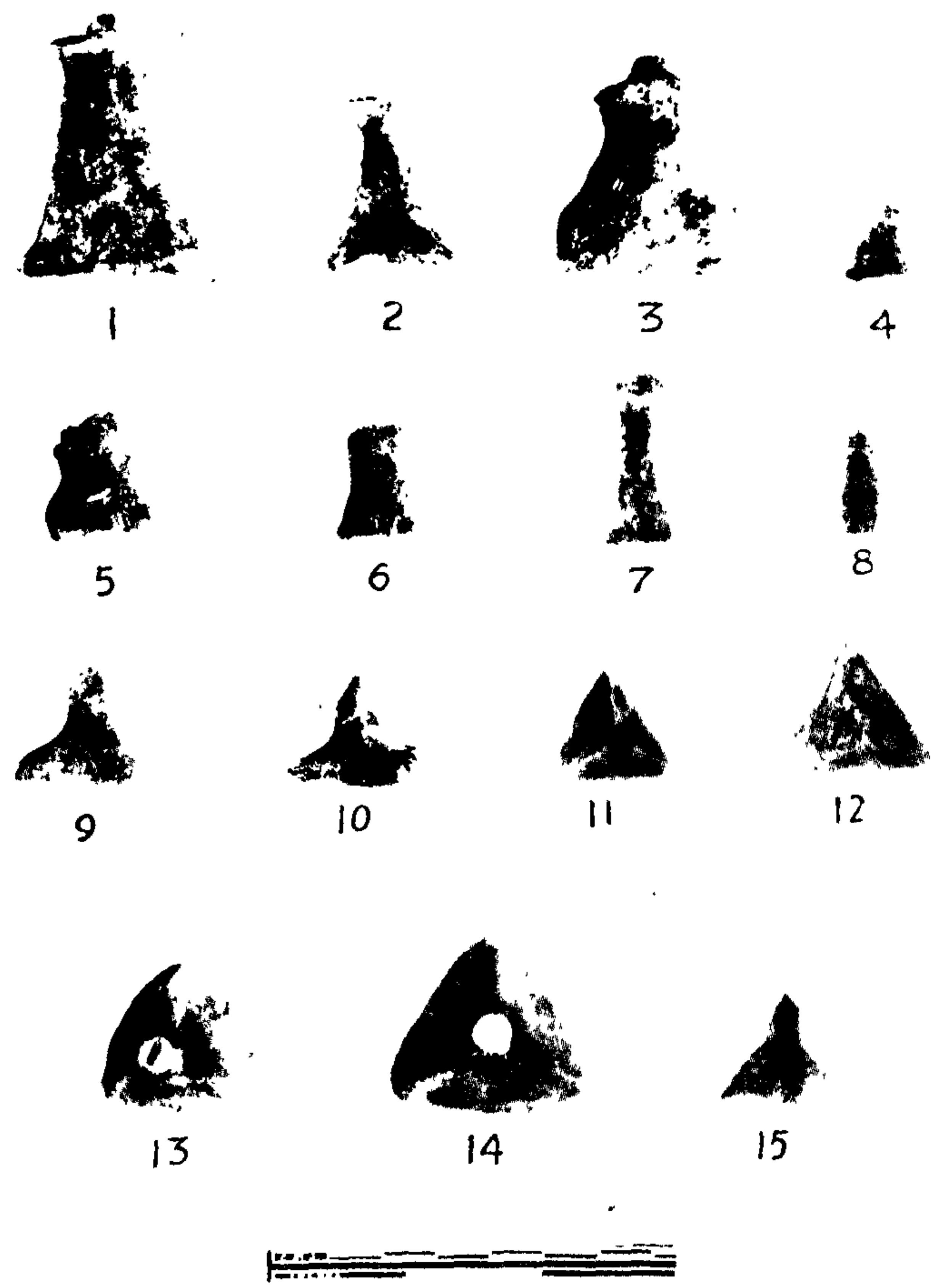


B

A, *Terracotta ladle. Period A*; B, *Zoomorphic gaming pieces (terracotta). Period A. See pp. 502 and 507*



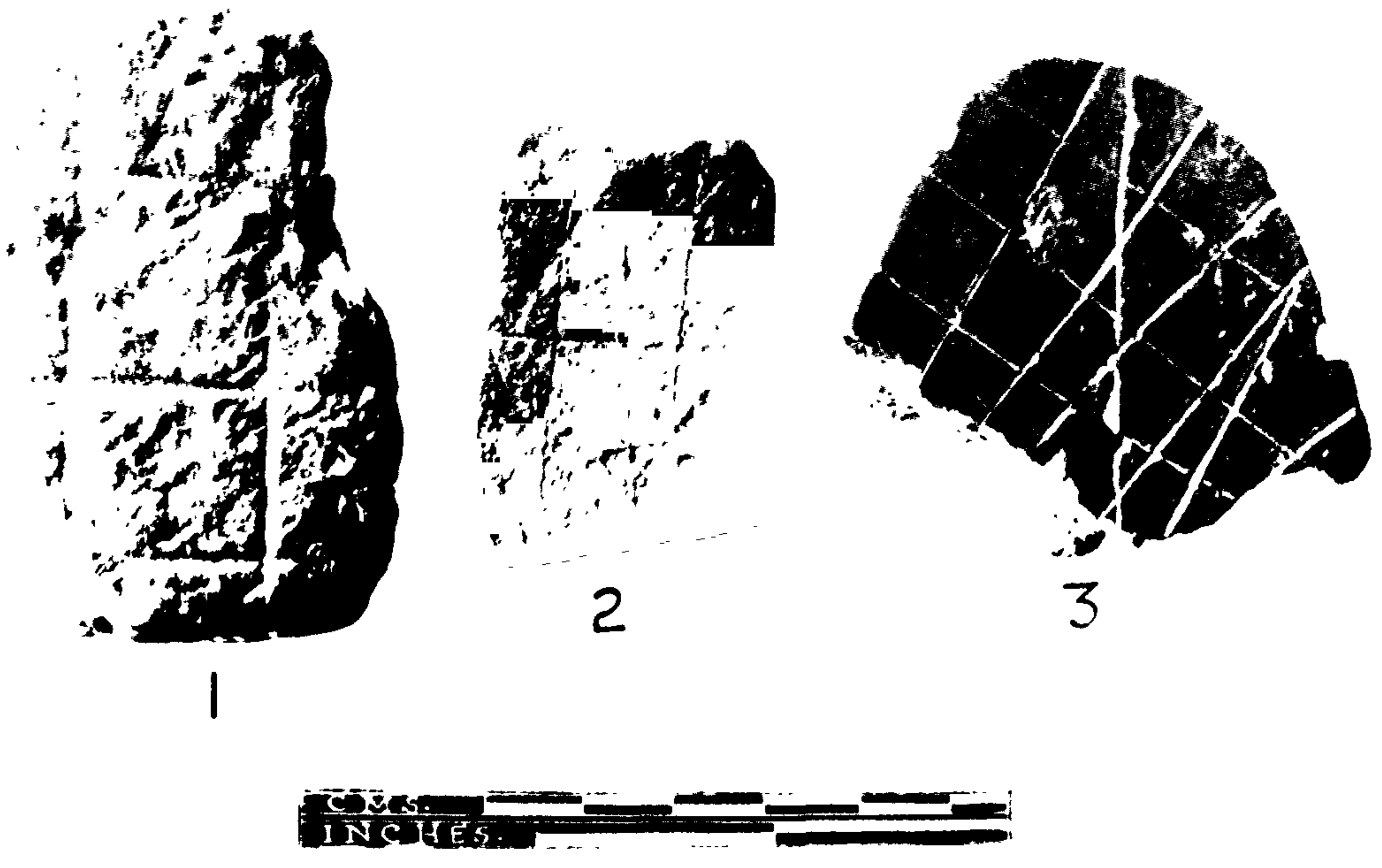
A



B

A and B. *Terracotta gamesmen.* A. *Pellets and cones;* B. *Castles and tetrahedrons etc.* *Period A* *See pp* 502, 507 *and* 508

A

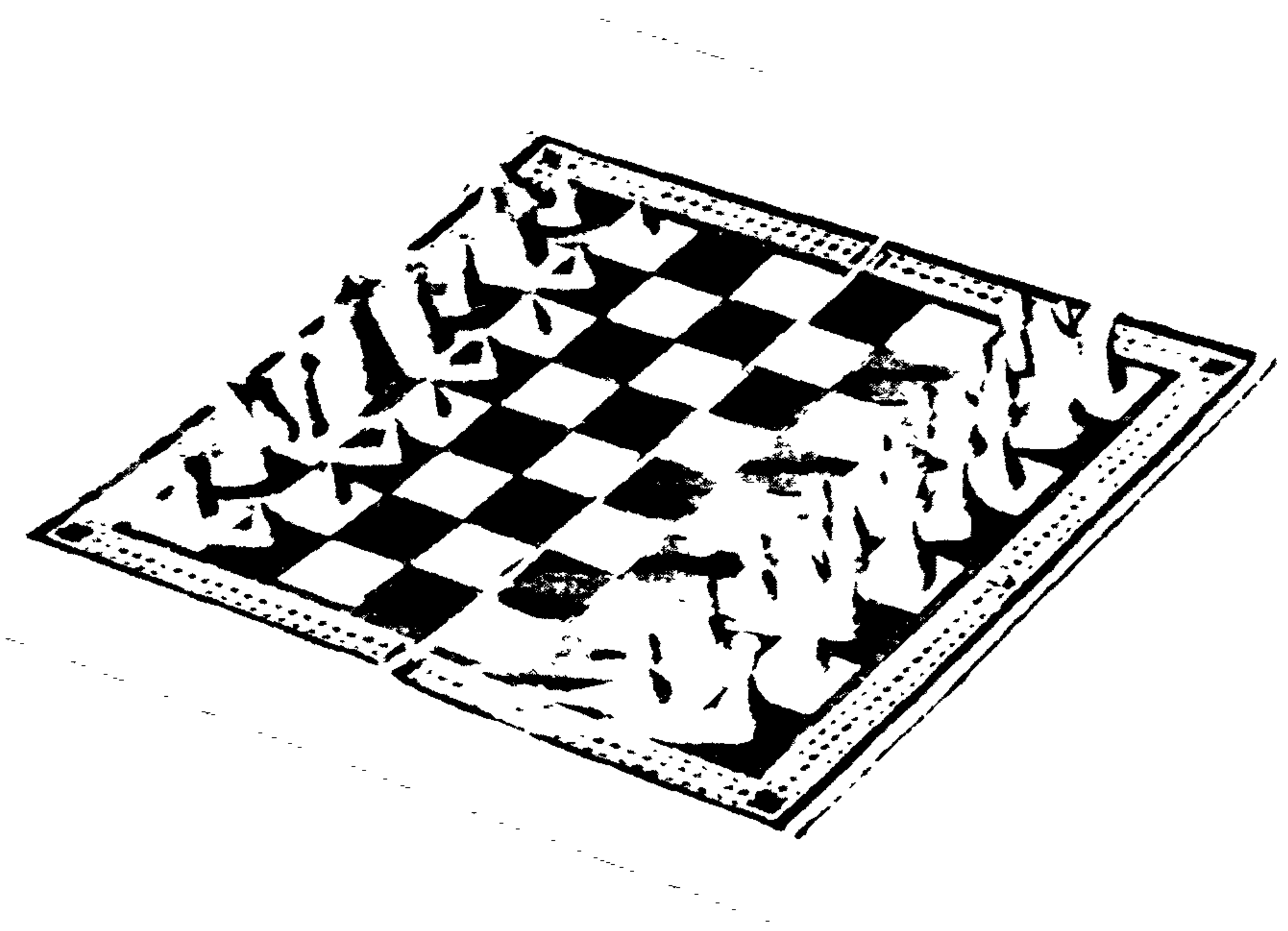


B

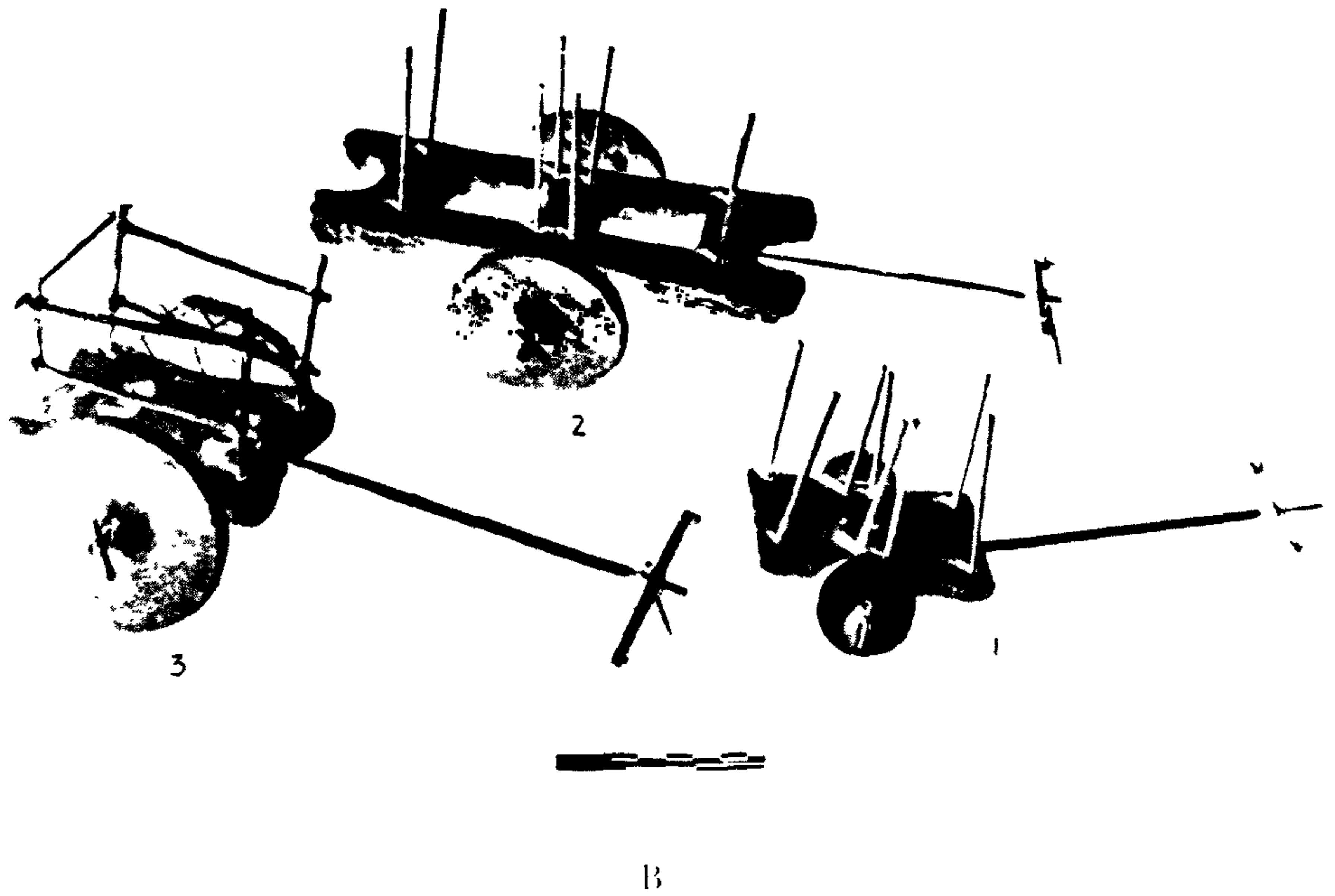
A. *Terracotta dice.* B. *1-2. Terracotta game boards; 3. T. C. Cake.* See pp. 503, 504, and 509

PLATE CCXX

Terracotta model of a ship (sail and sailor are restored). *See p. 505*



A

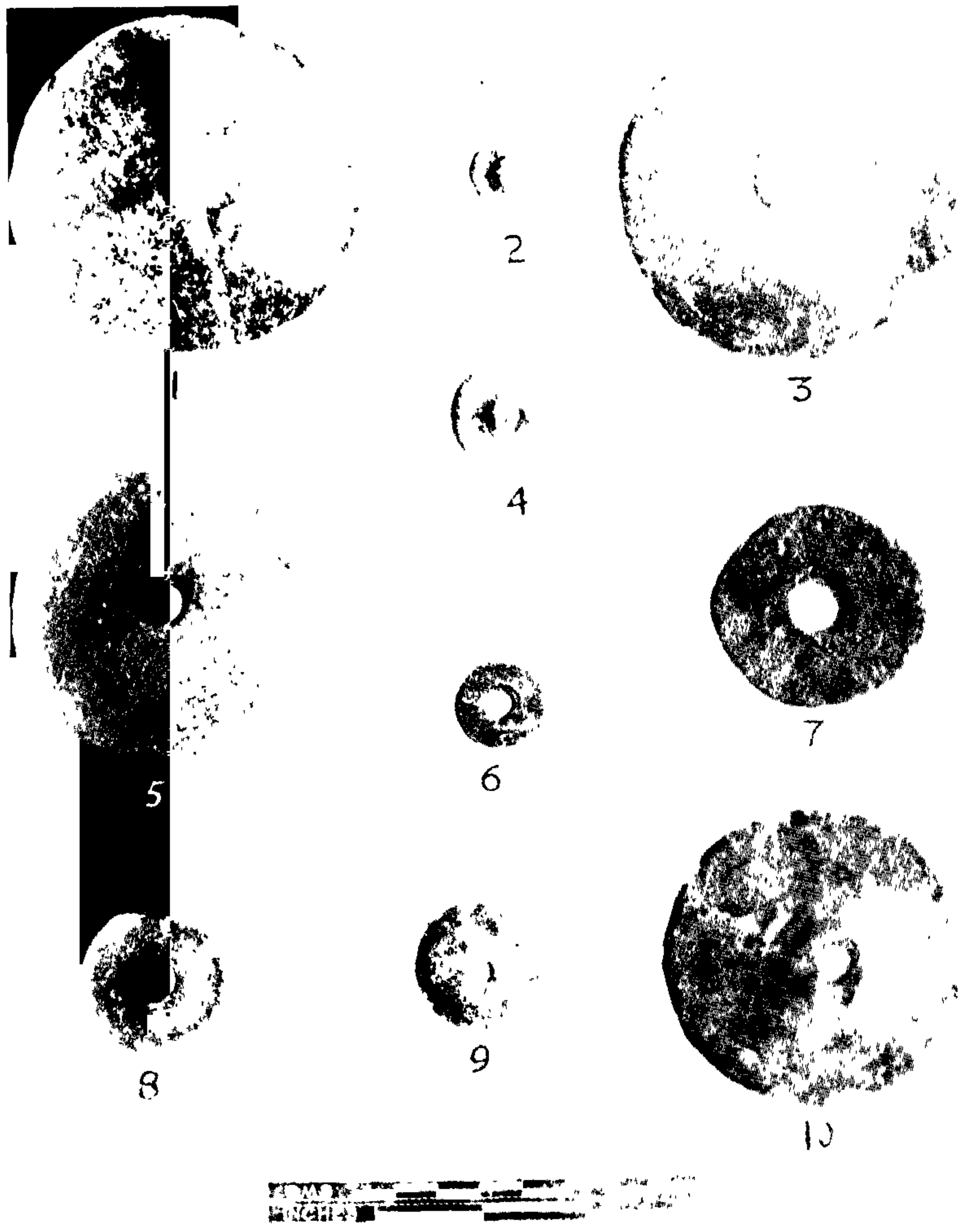


B

A. *A modern chess board with gamesmen from Lothal (on the left) compared with the modern chessmen (on the right).* B. *Terracotta toy-carts, wooden pegs and yoke restored.* *See pp.* 503, 504 *and* 509

PLATE CCXXII

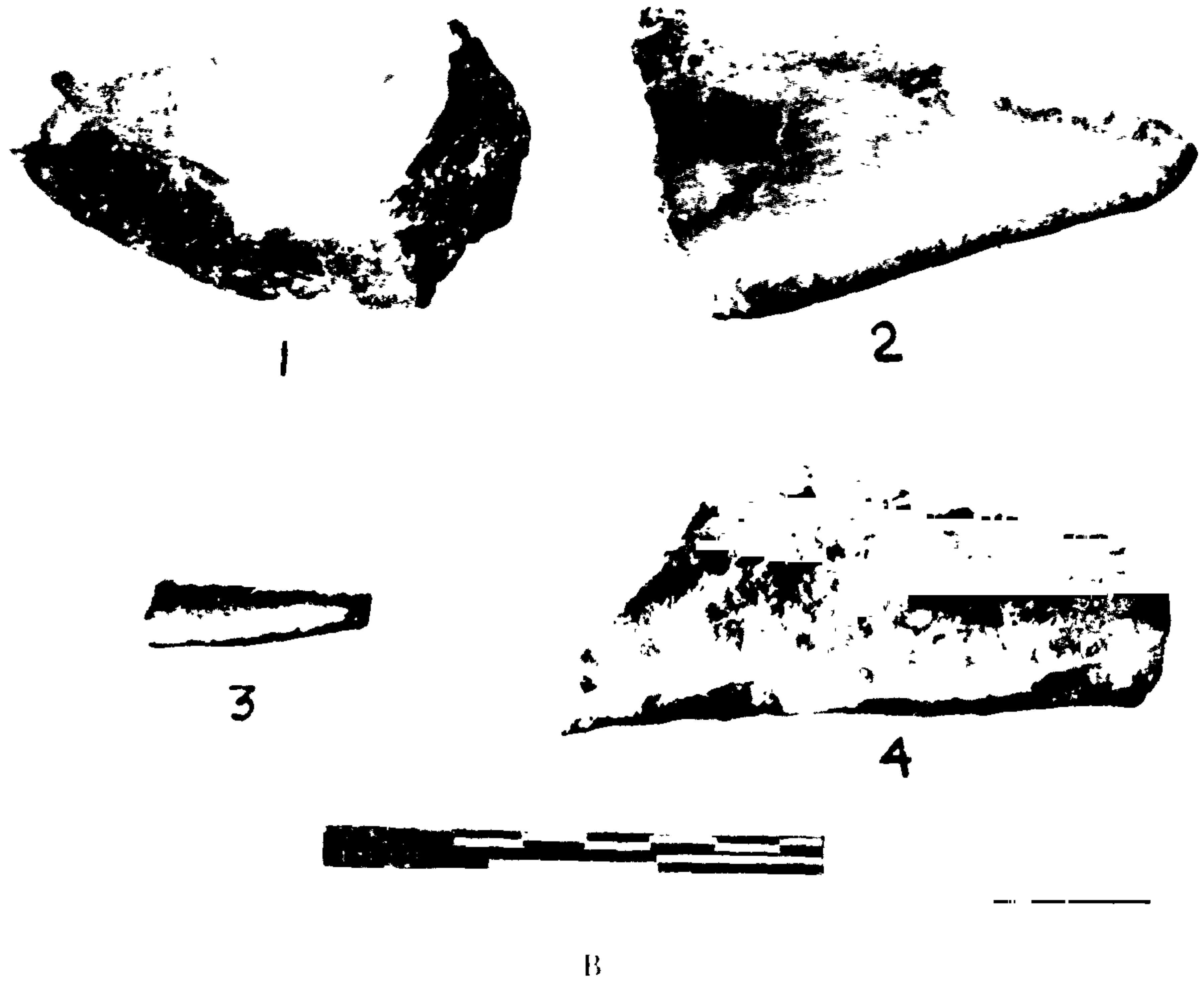
A



B

A. *Terracotta cart-frames Period A*; B. *Terracotta wheels Periods A and B* *See pp. 504, 509 and 511*

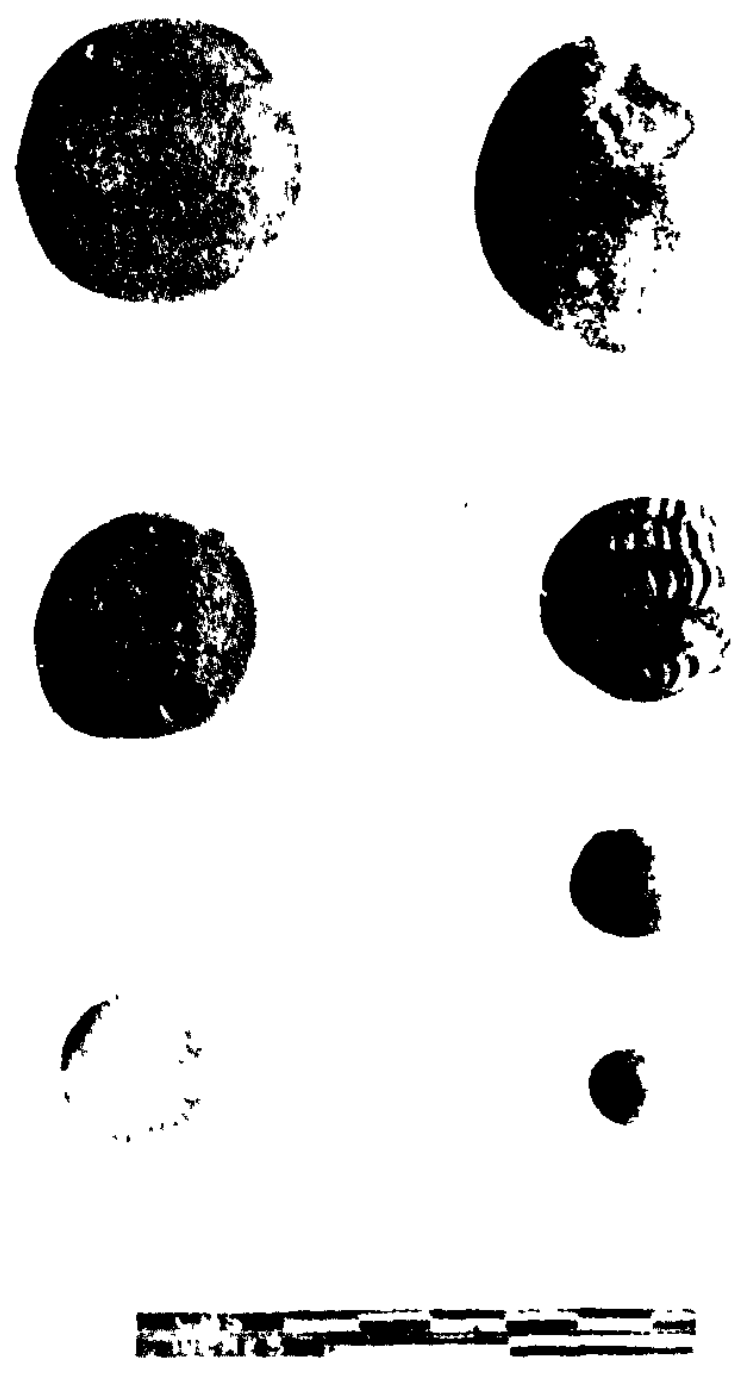
A



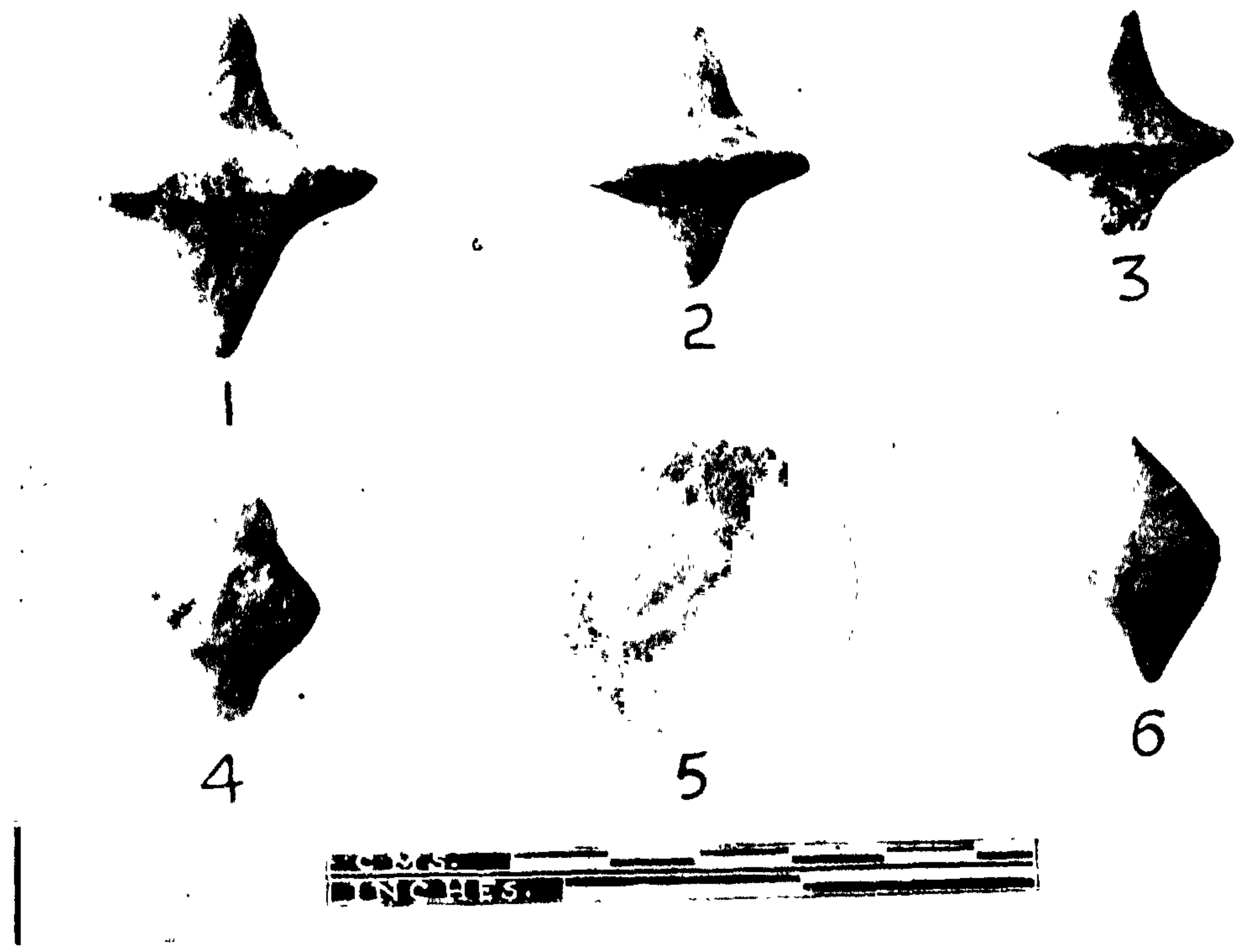
B

A. *Miniature terracotta boat with a pointed prow, sharp keel and holes for mast etc. Period A.* B. *Terracotta boats, 1 with a sharp keel, 2-4 with flat-base Periods A and B.* See *pp.* 511 and 513

PLATE CCXXIV

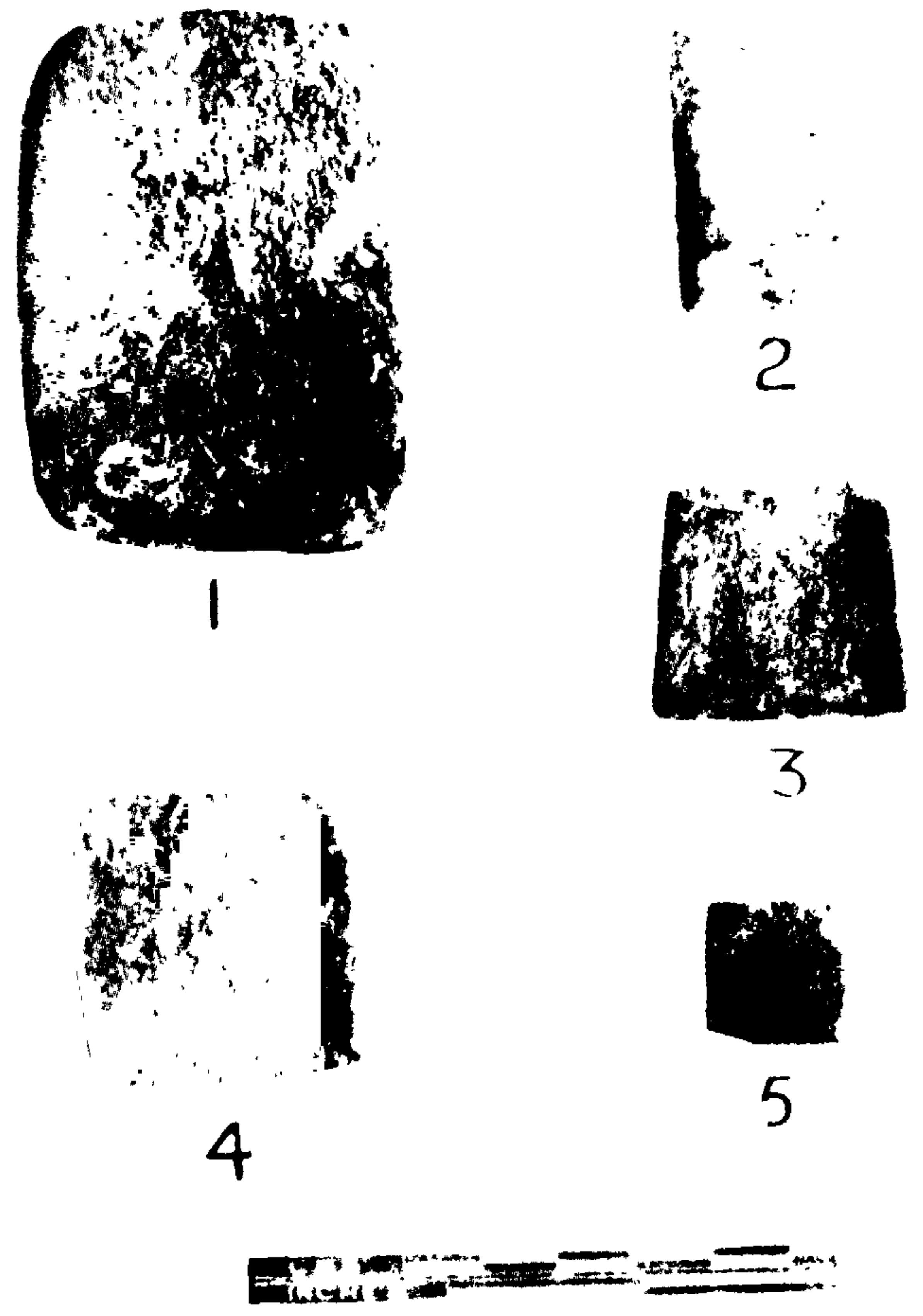


A

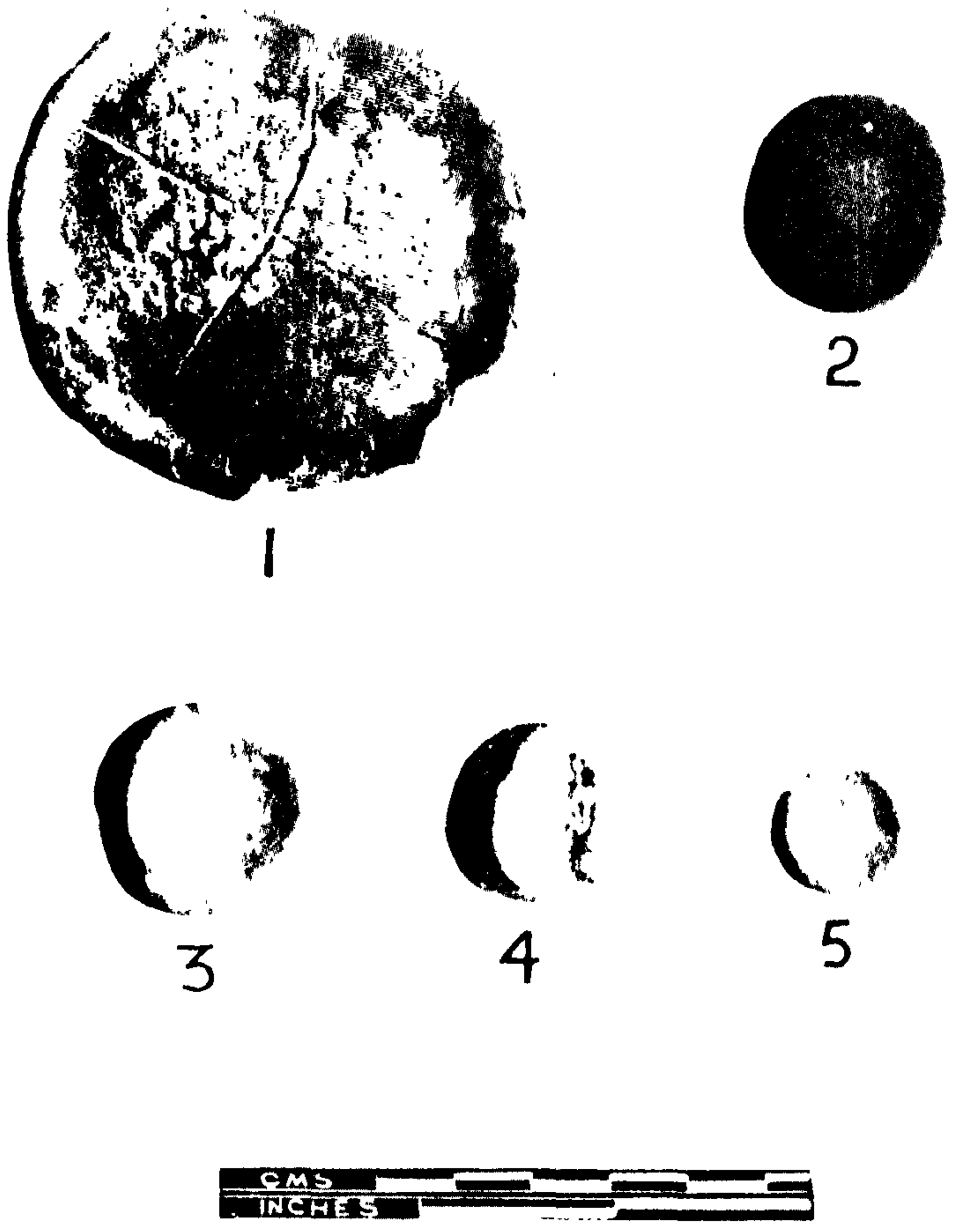


B

A. *Terracotta marbles Period I*. B. *Terracotta spinning tops Periods A and B*. *See p.* 513



A



B

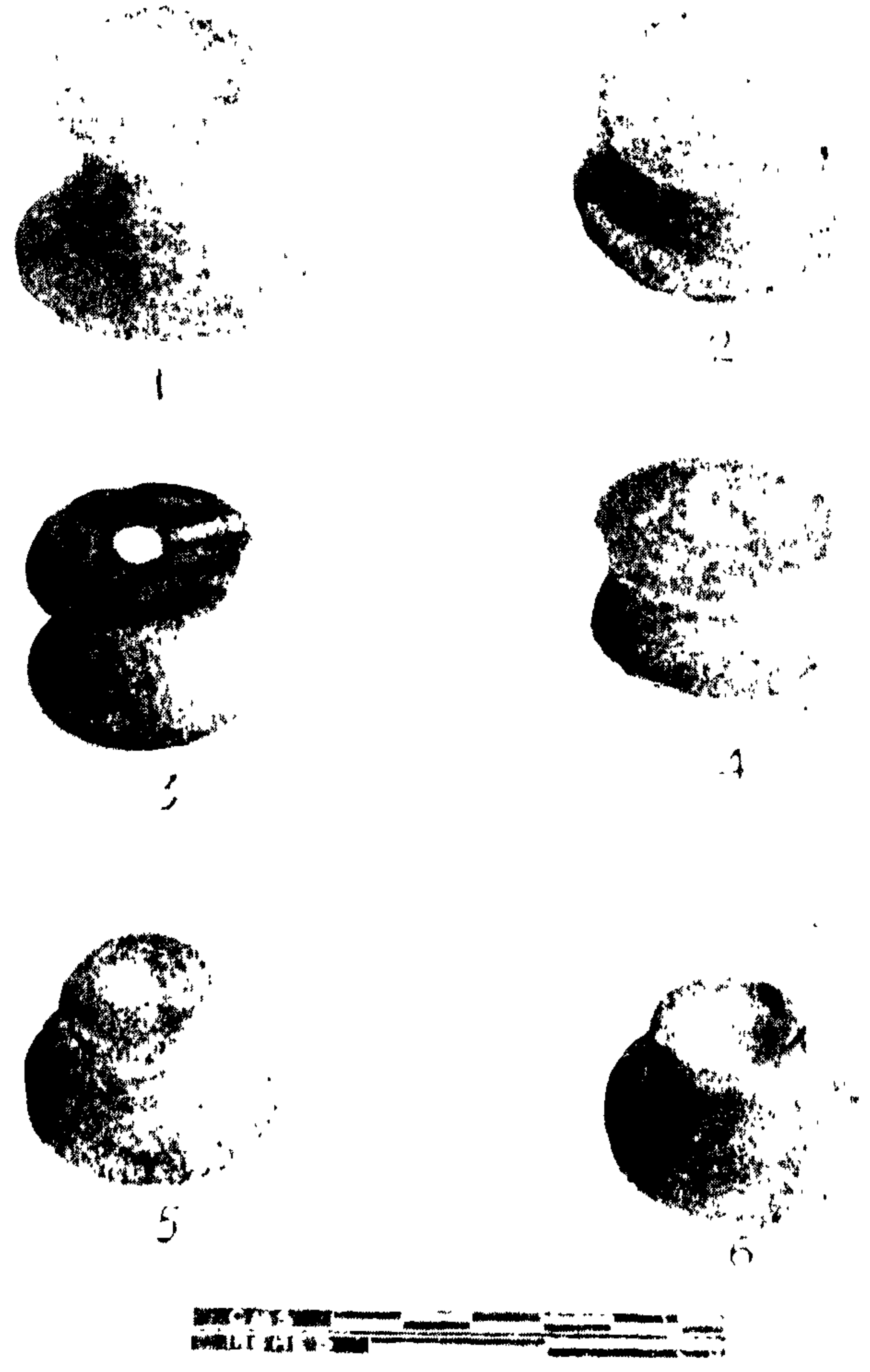
A, *Terracotta tablets* *Periods A and B* ; B, *Terracotta discs etc.* *Periods A and B.* *See pp. 513 and 514*

PLATE CCXXVI

A

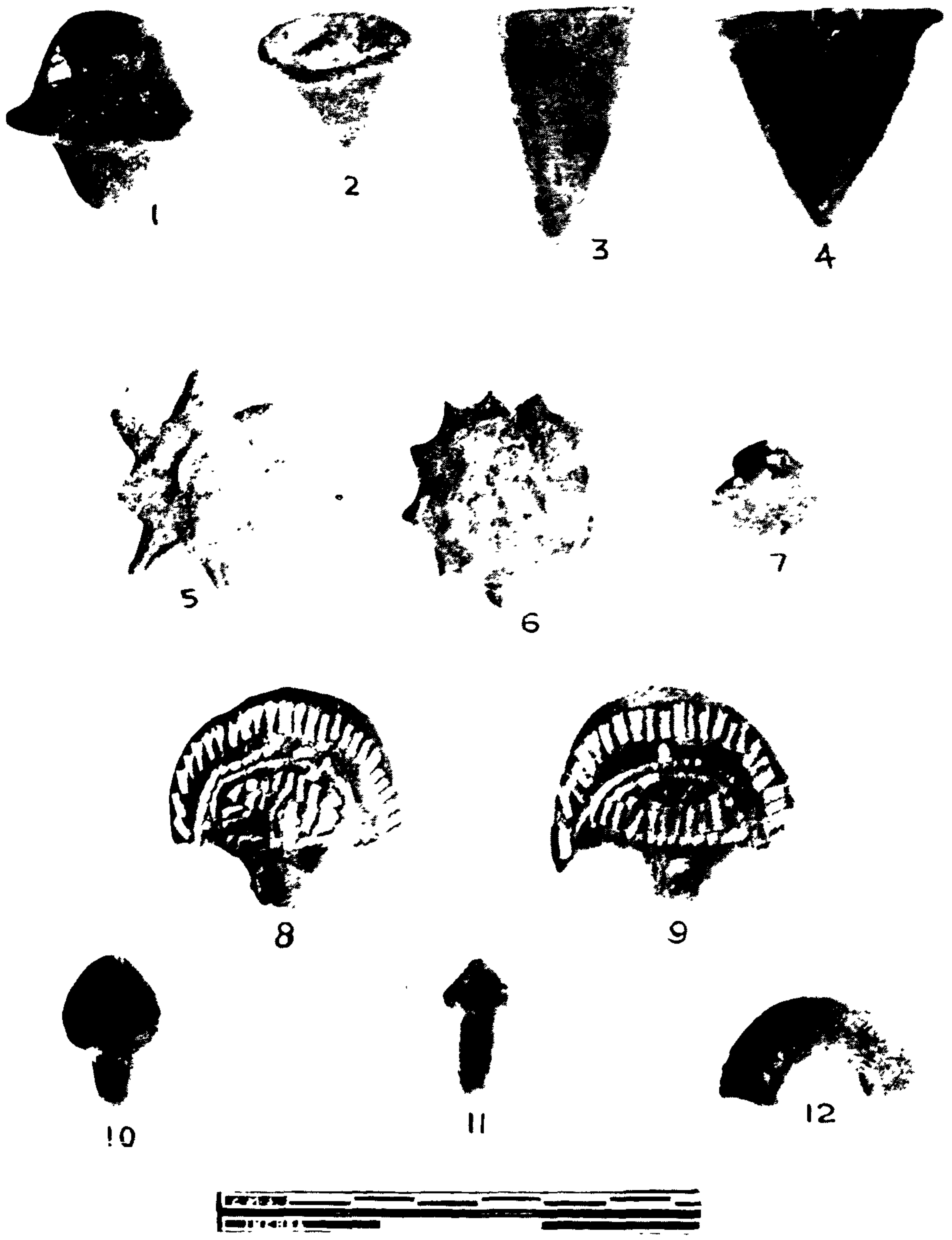
B

A. *[illegible], Period A.* B. *1 Vessel, 2 nail (terracotta), Period A.* See *p. 514*

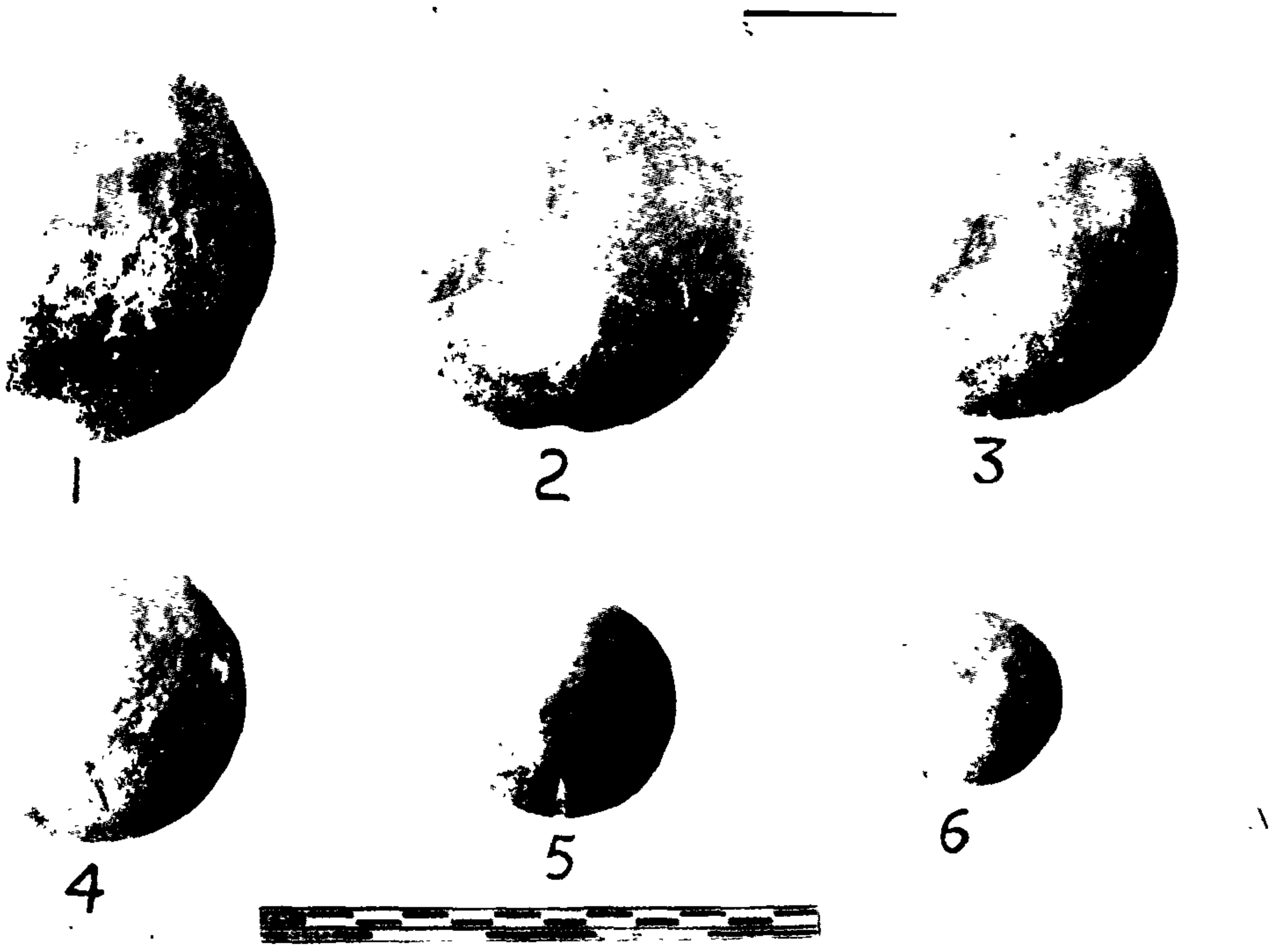


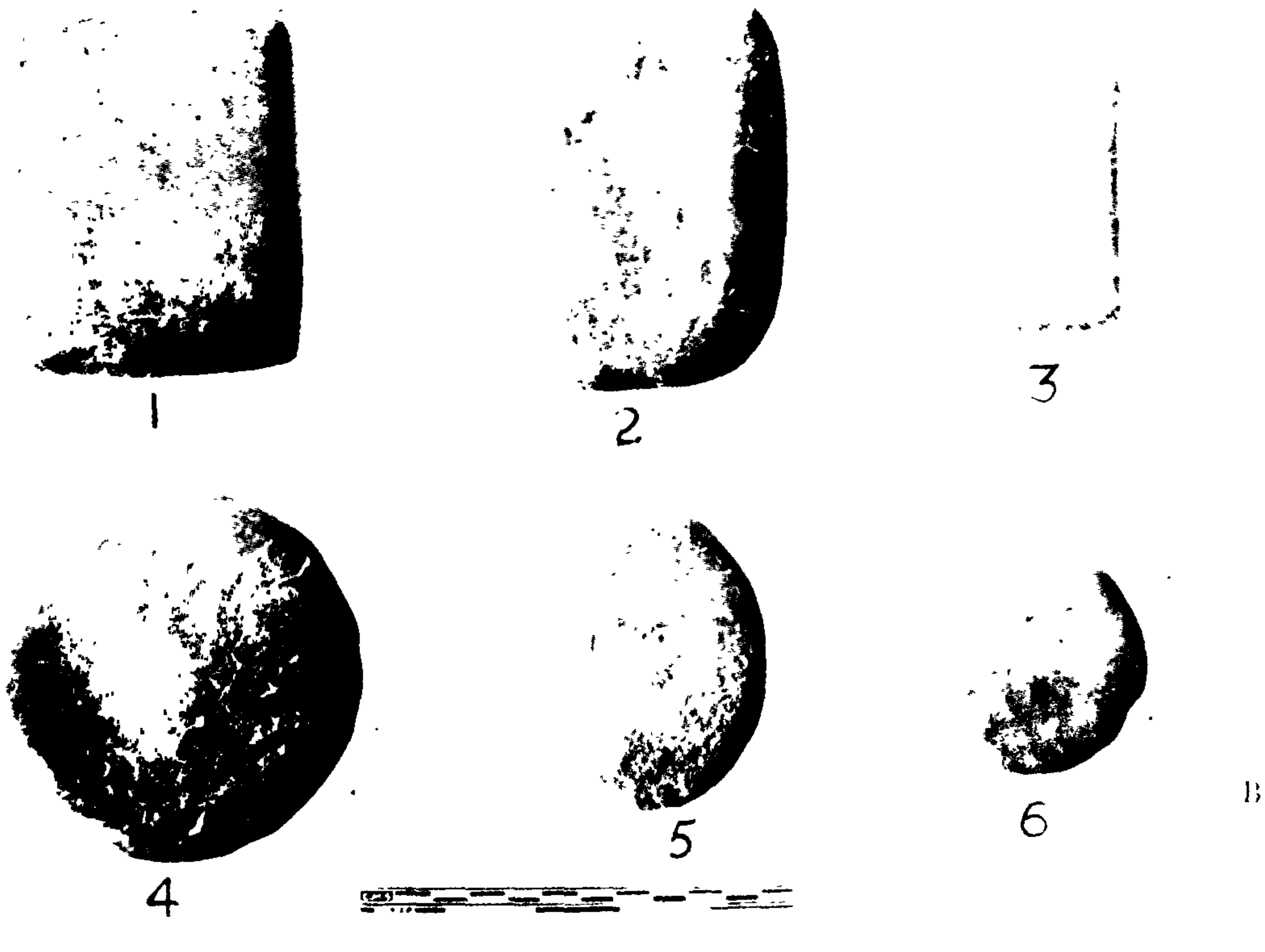
A — B

A *Terracotta cones and spheres Period I* B *Terracotta ear pendants Periods I and II* See pp 514 and 516

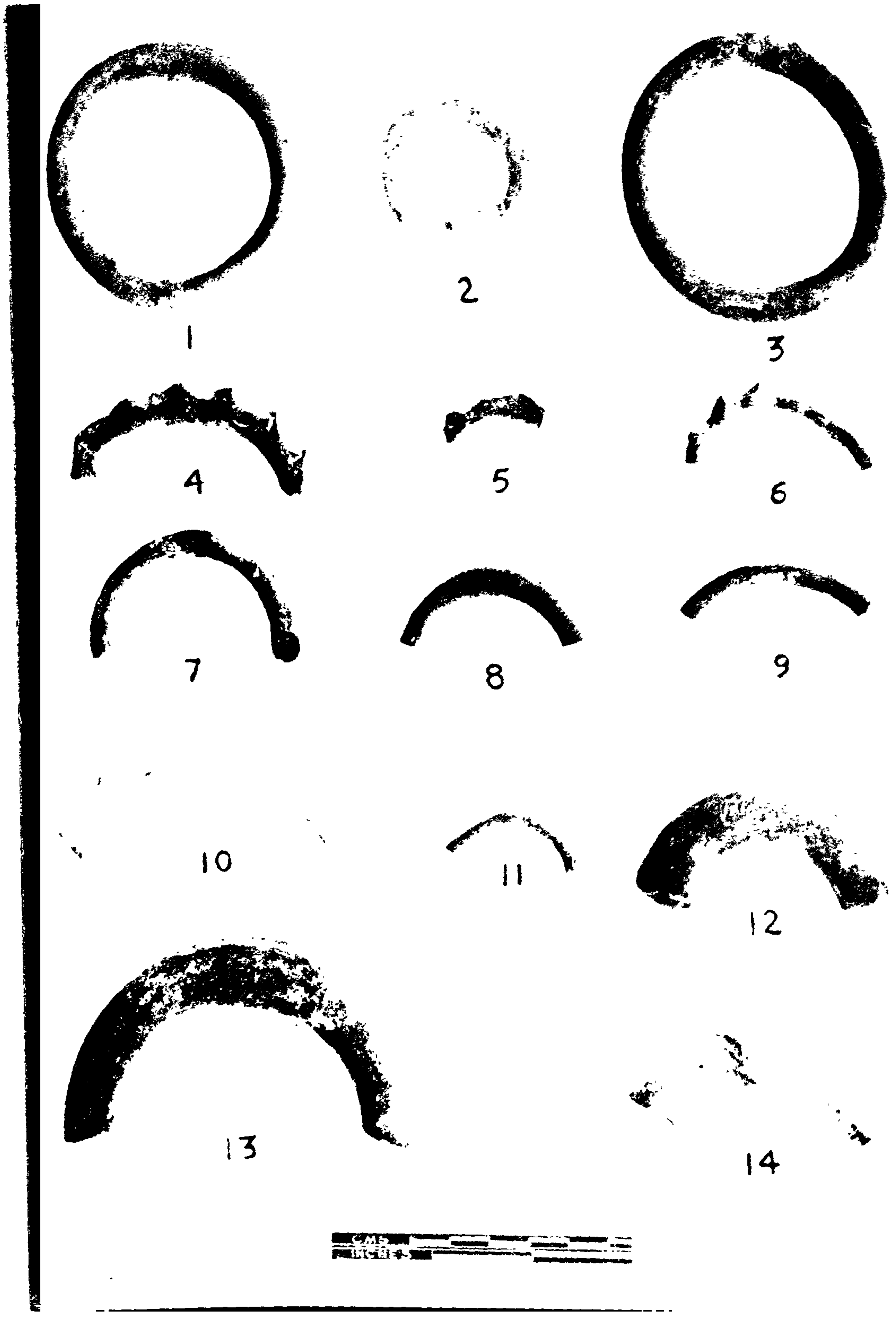


Terracotta ornaments. 1-4 Pendants; 5-7 and 10-11 ear-studs; 8-9 studs of hair-pins; 12 ear-ring. Period A. See pp. 515 and 516

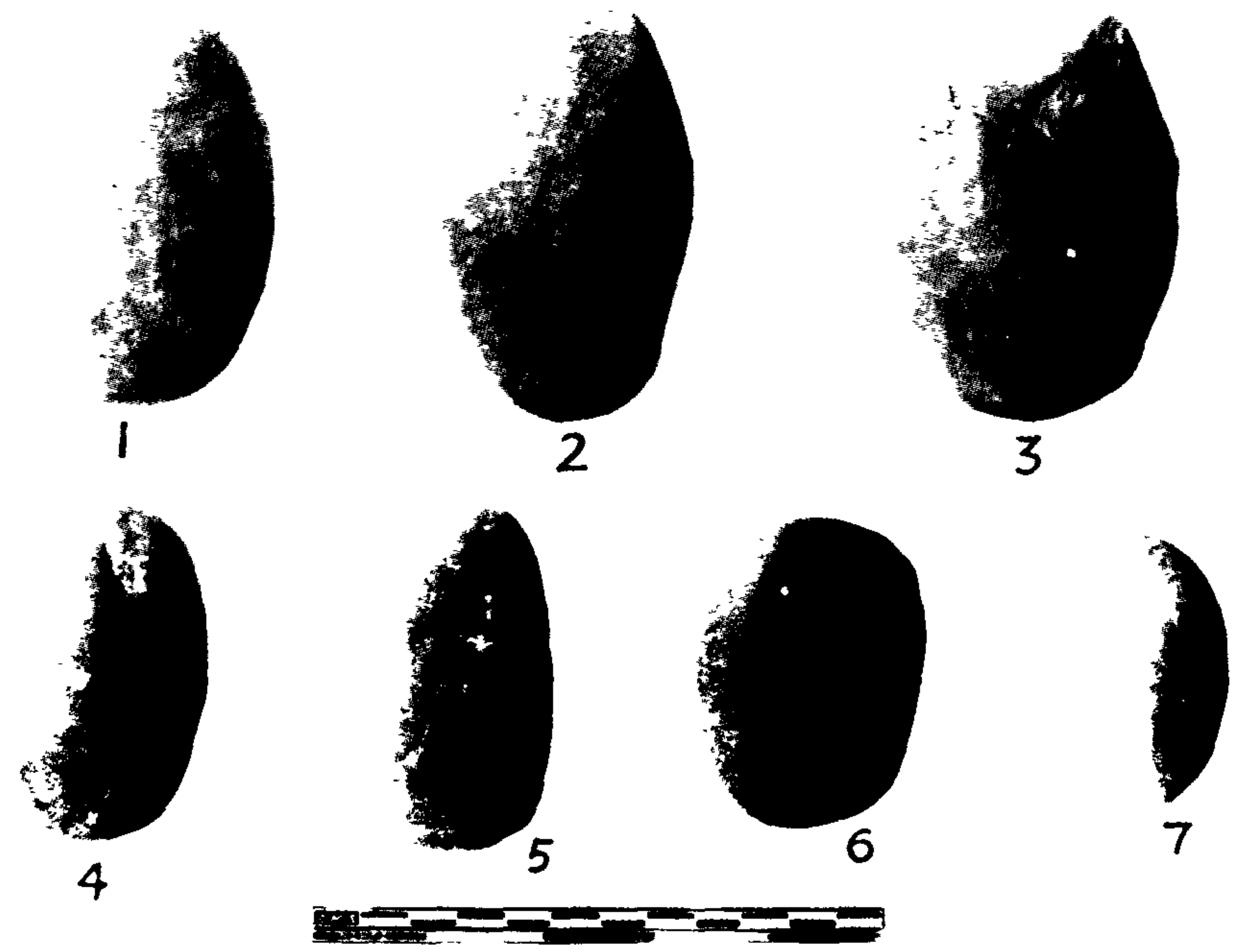




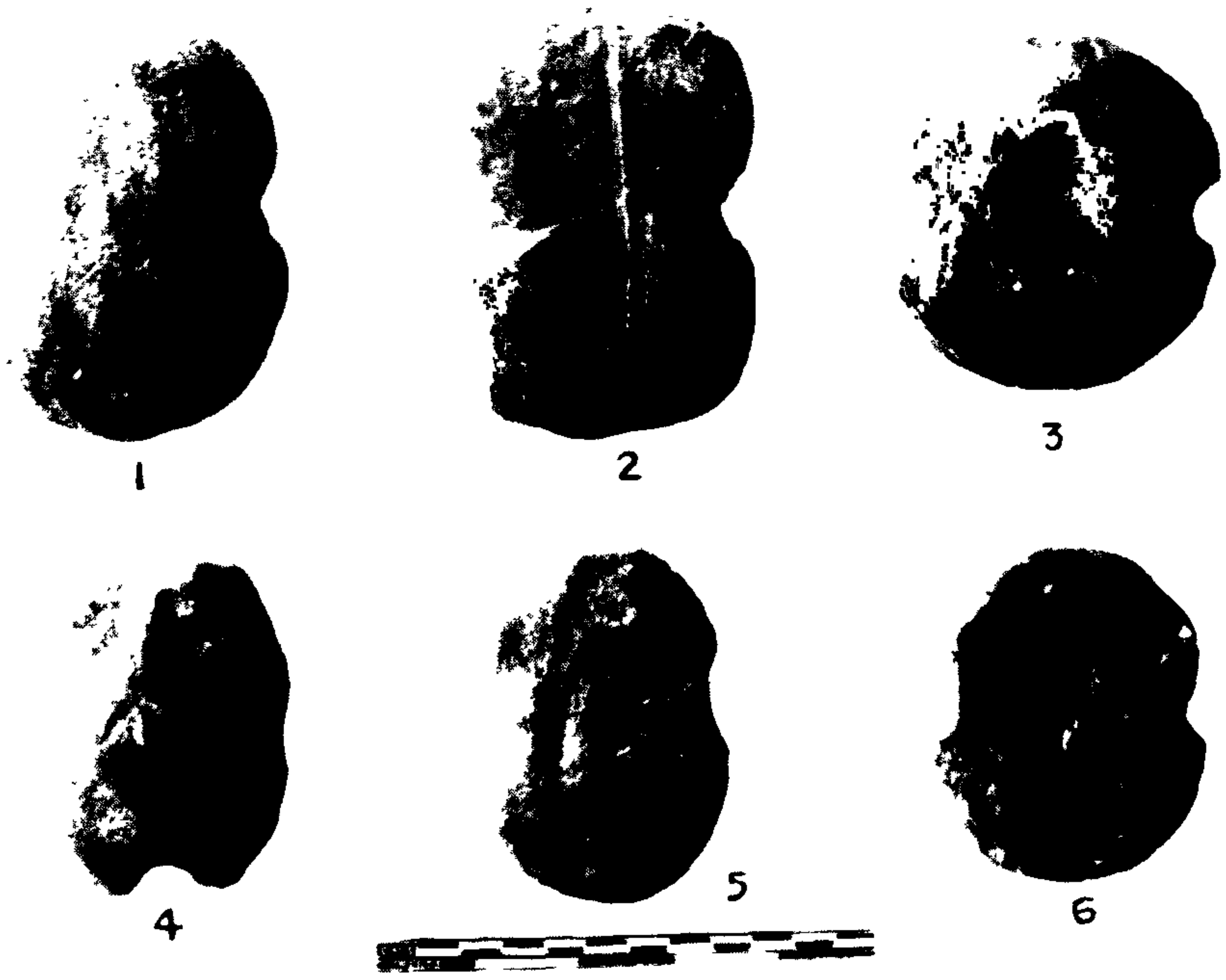
A, *Terracotta balls Period B*. B, *Terracotta pellets; sling balls Period A* *See p. 517*



Terracotta bangles Period A. *See p. 717*



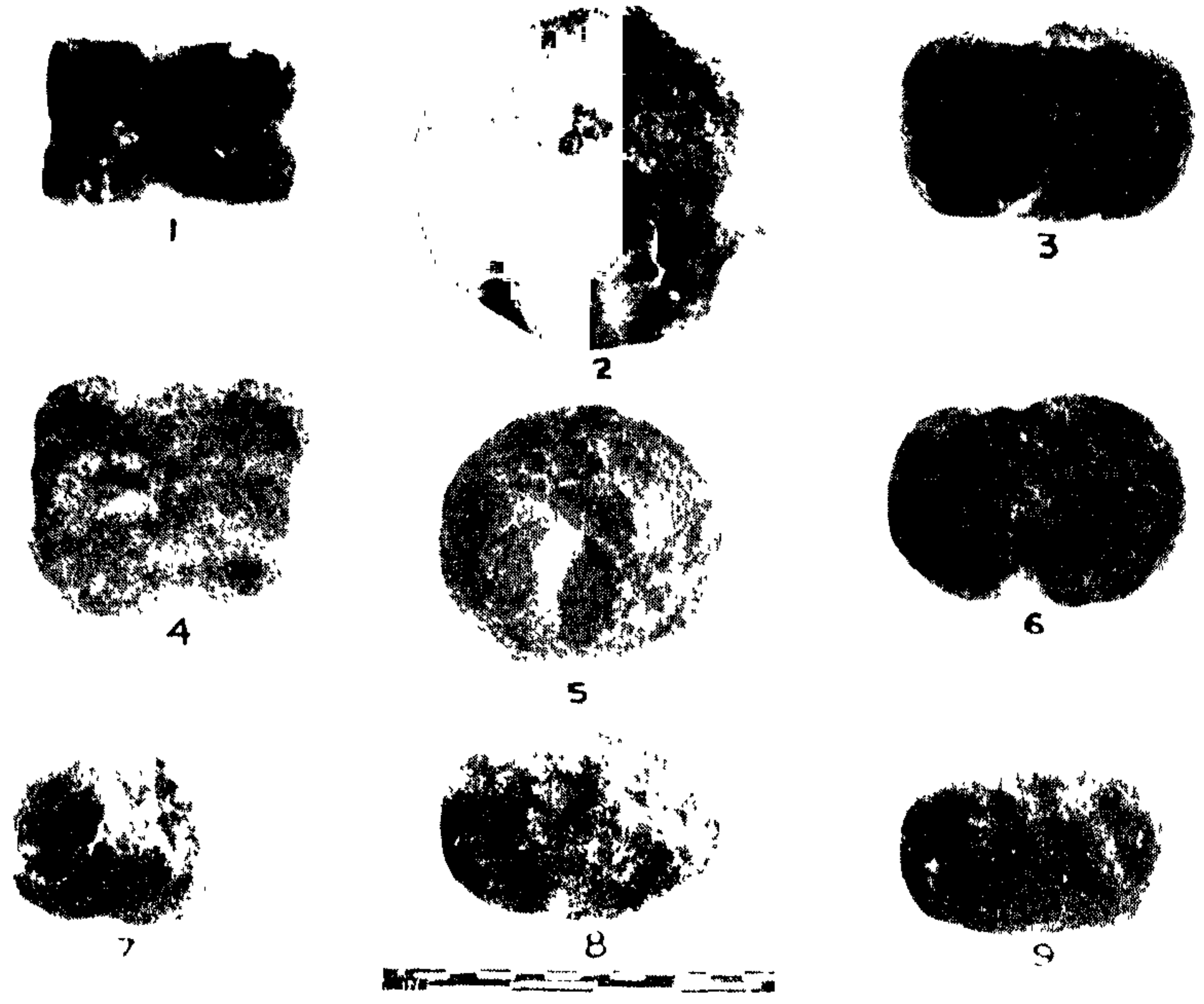
A



B

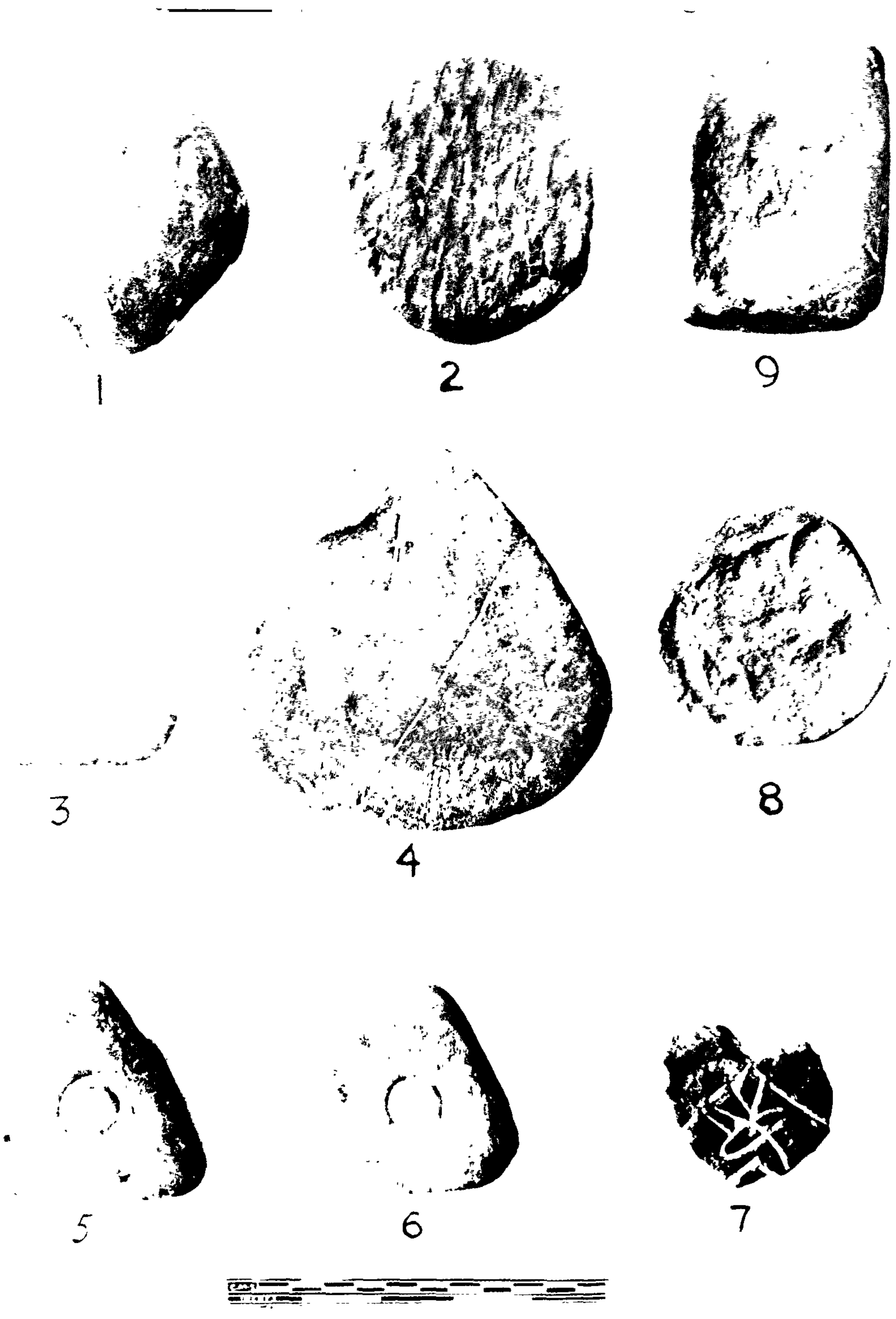
A. *Terracotta ovoid pellets. Period B*; B. *Terracotta net-sinkers or ritual objects with finger-marks. Period A.* *See p. 518*

A

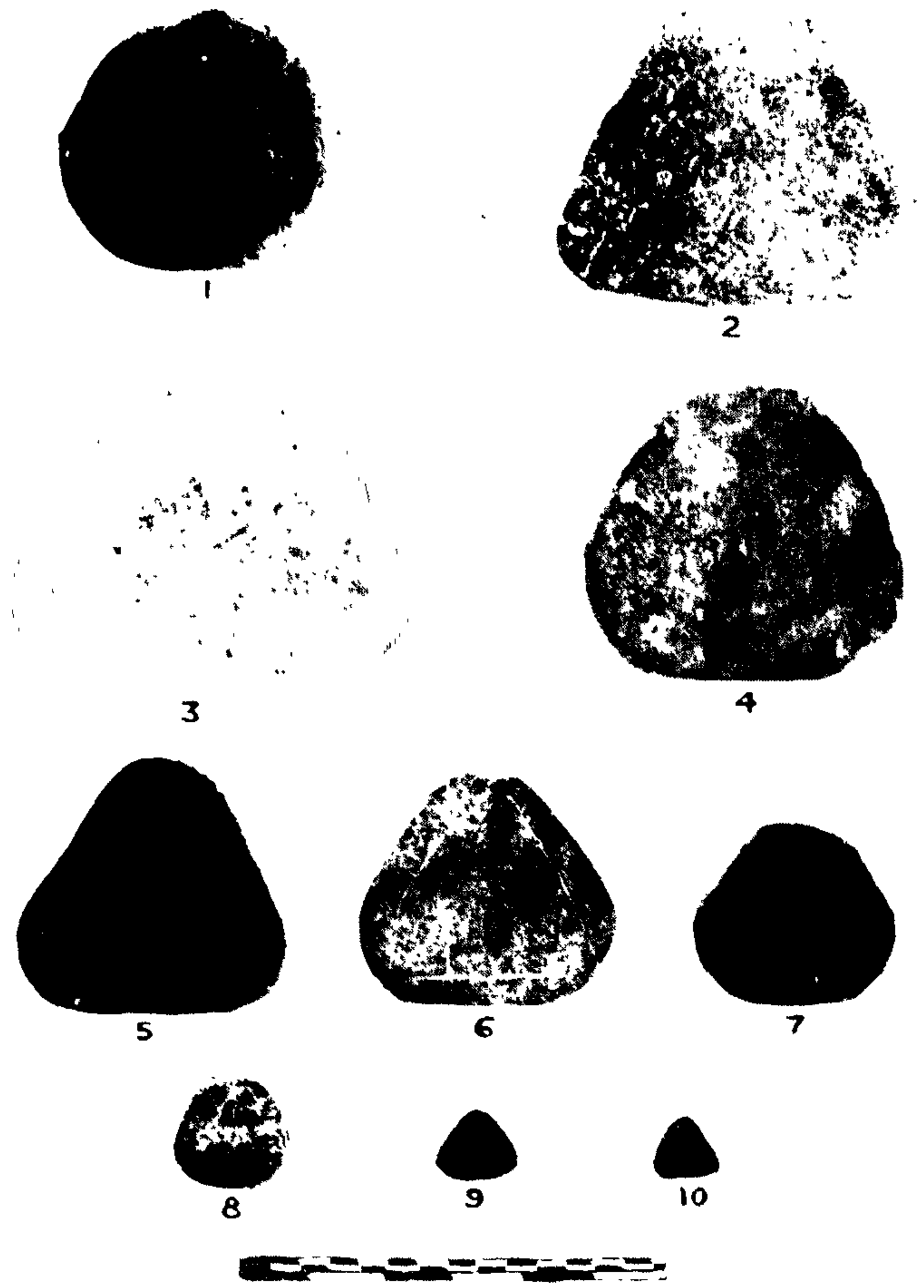


B

A, *Cuboid and spheroid net-sinkers or ritual objects with finger-marks (terracotta) Period A*; B, *Ovoid net-sinkers with four finger-marks (terracotta) Period B.* *See p. 518*



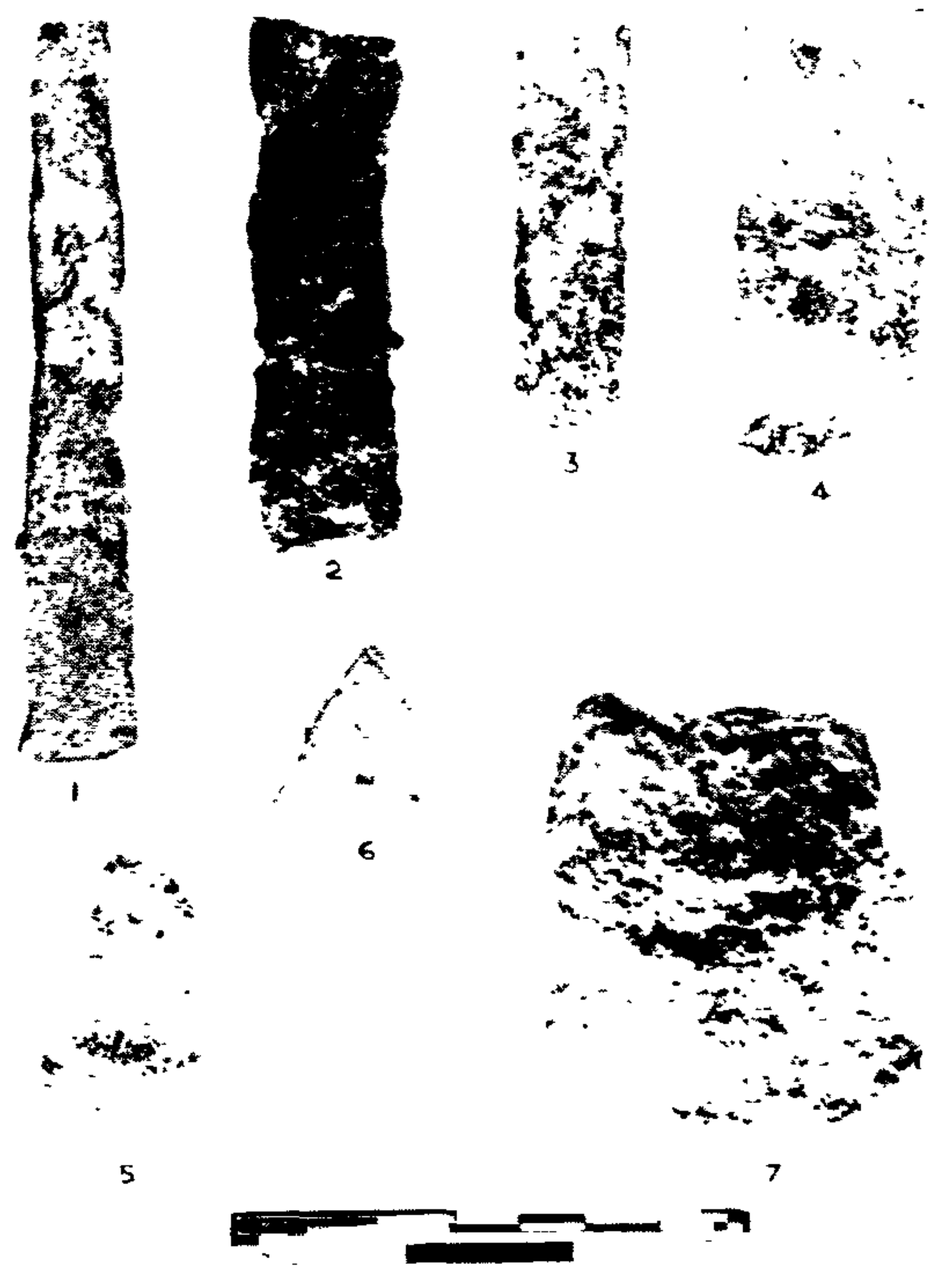
1-2 spheroid pellets with basket impressions; 3-4 triangular 'cakes' with graffiti; 5-9 'cakes' stamped with designs (terracotta) Period A. *See p. 518*



A

B

A. *Terracotta triangular 'cakes', Period I.* B. *Terracotta scale-pans used in a reconstructed weighing scale.* See p. 519



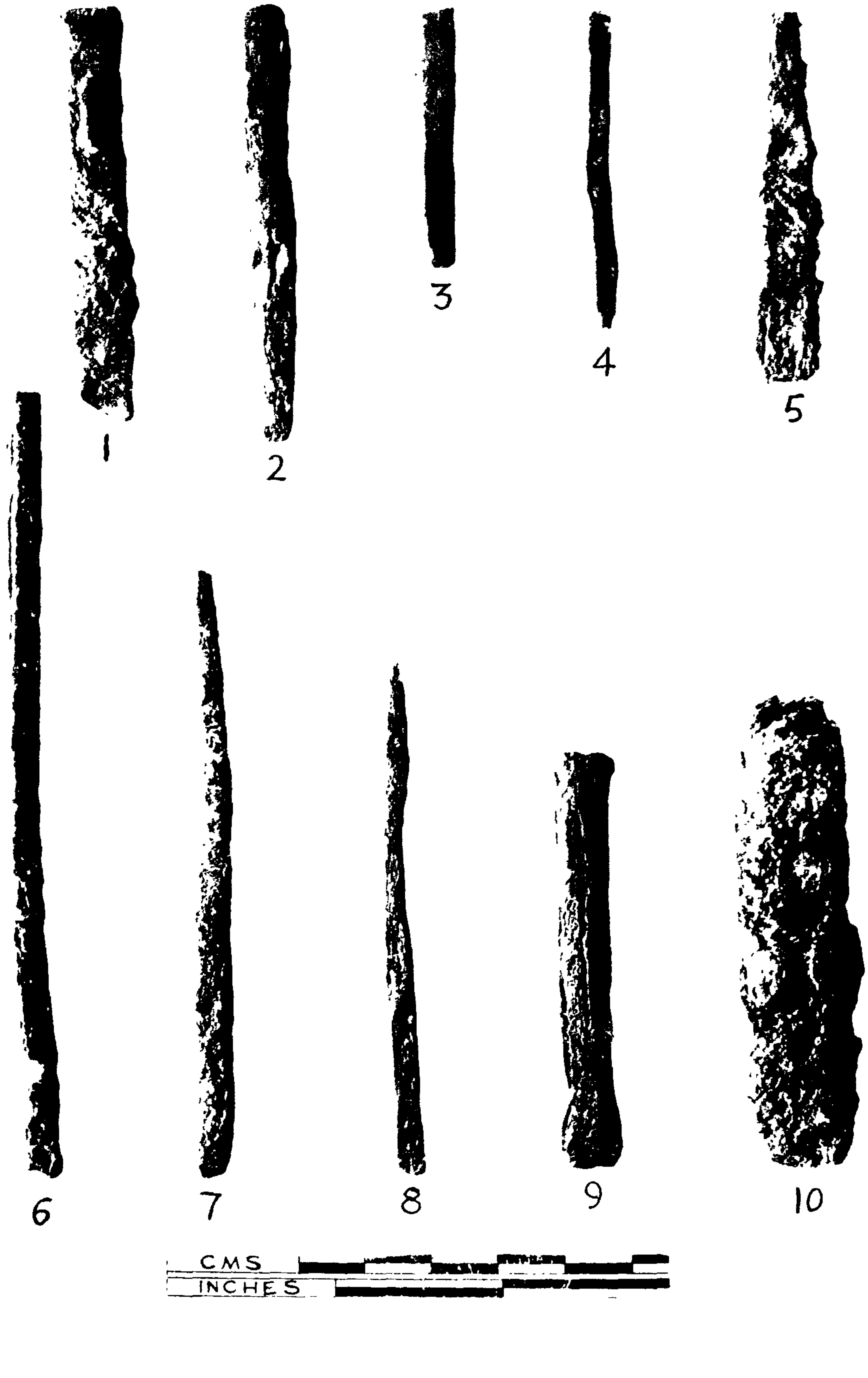
A

B

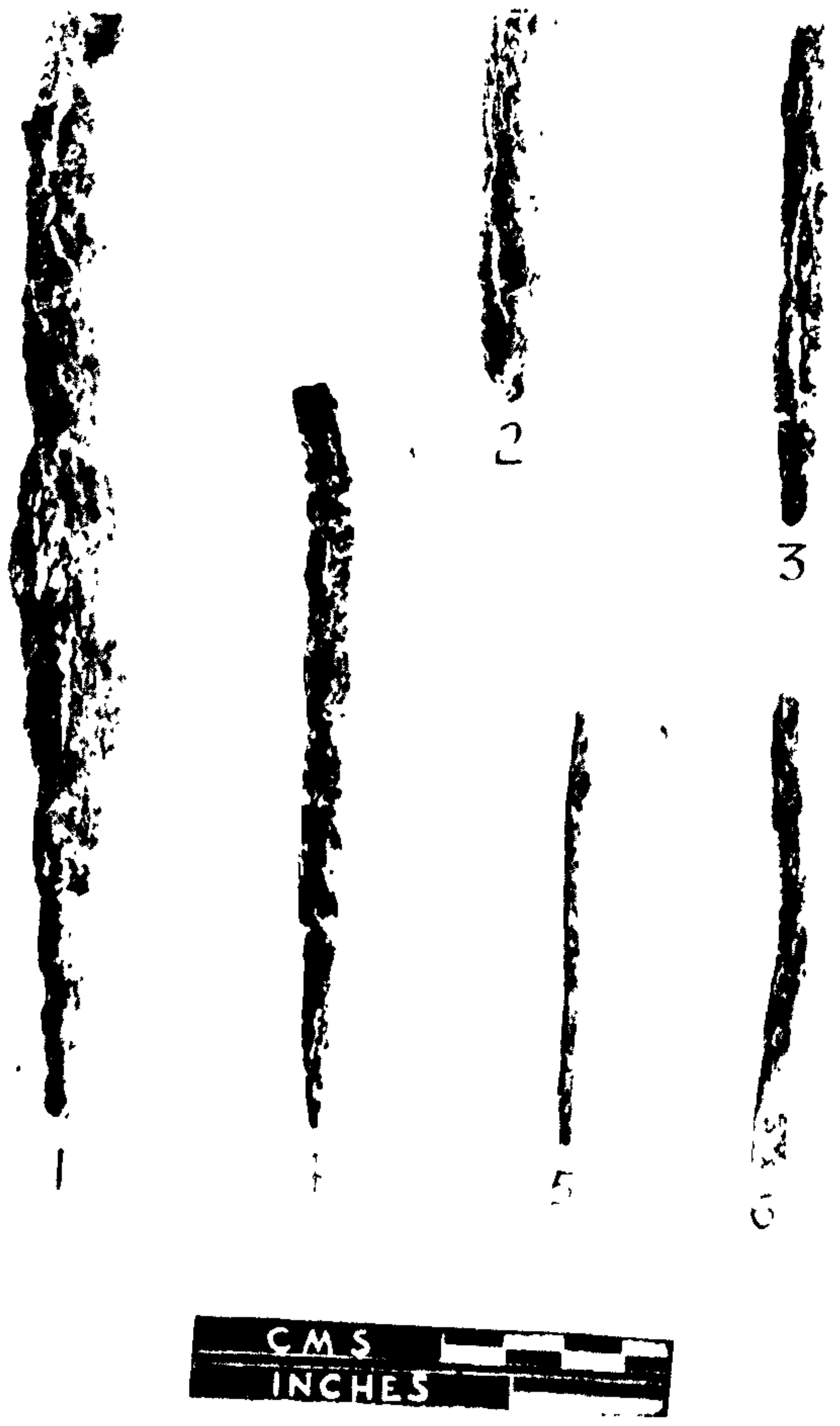
A. *Copper and bronze axes. 1-4 blade axes; 5-7 transverse axes. Period A.* B. *Flat axe, copper and bronze. Period A. See pp. 521 and 536*

A B C

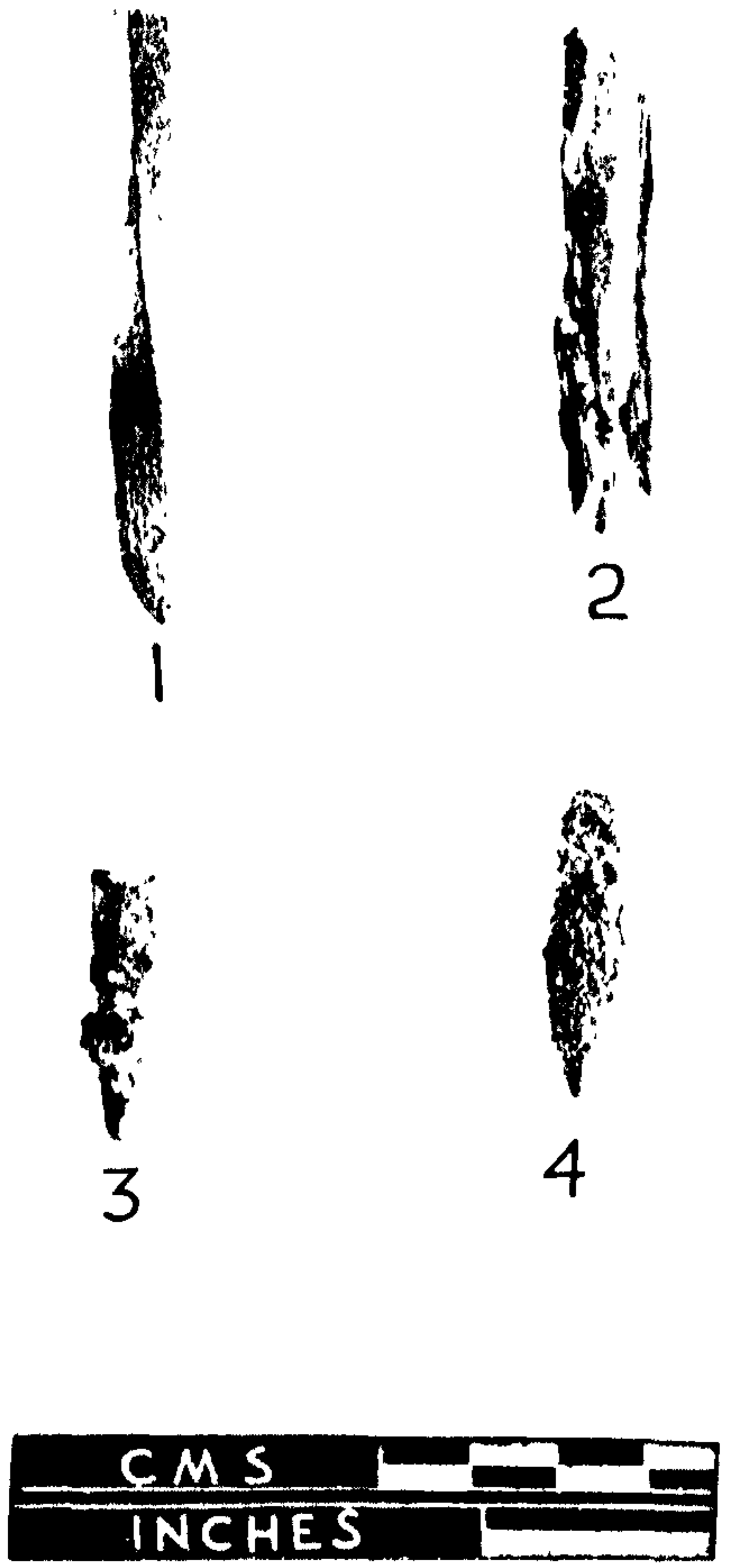
A, *Daggerheads (copper and bronze) Period A*; B, *Leaf-shaped incurved and lunate-shaped blades (copper and and bronze) Period A*; C, *Needles (copper and bronze) Period A*, *See pp. 539 and 543.*



Chisels (copper and bronze) Period A. *See p. 539*



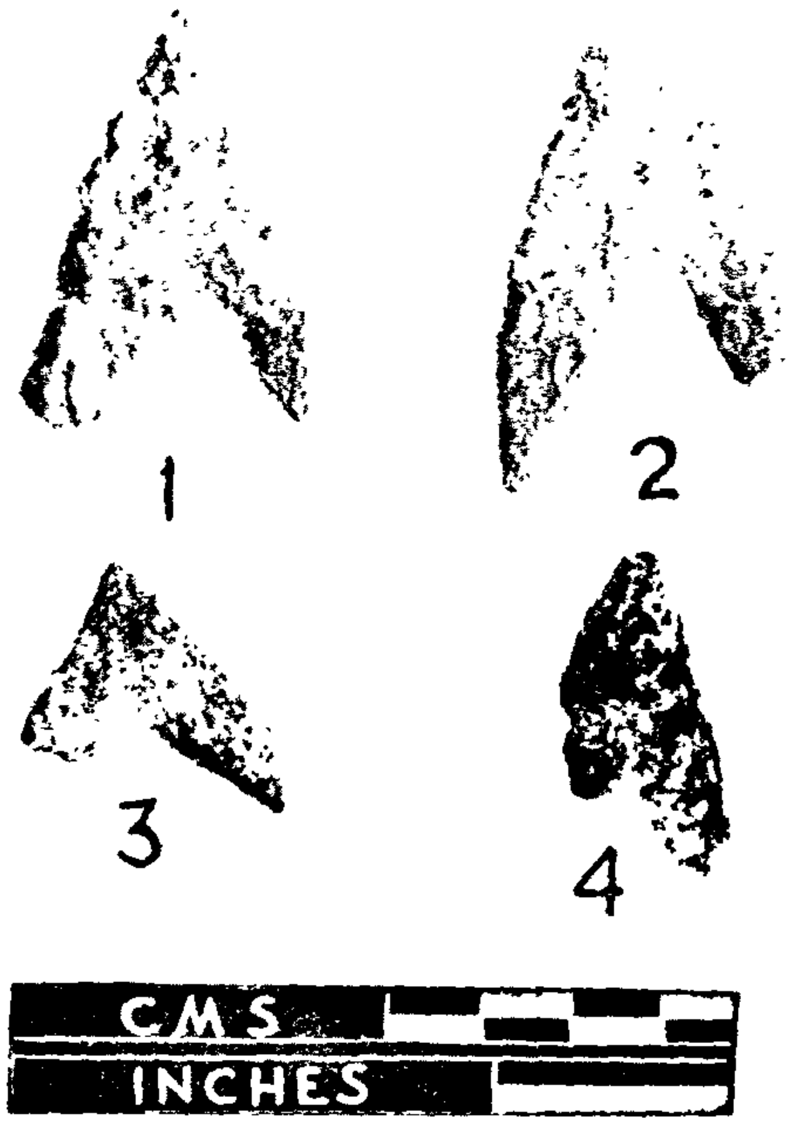
A



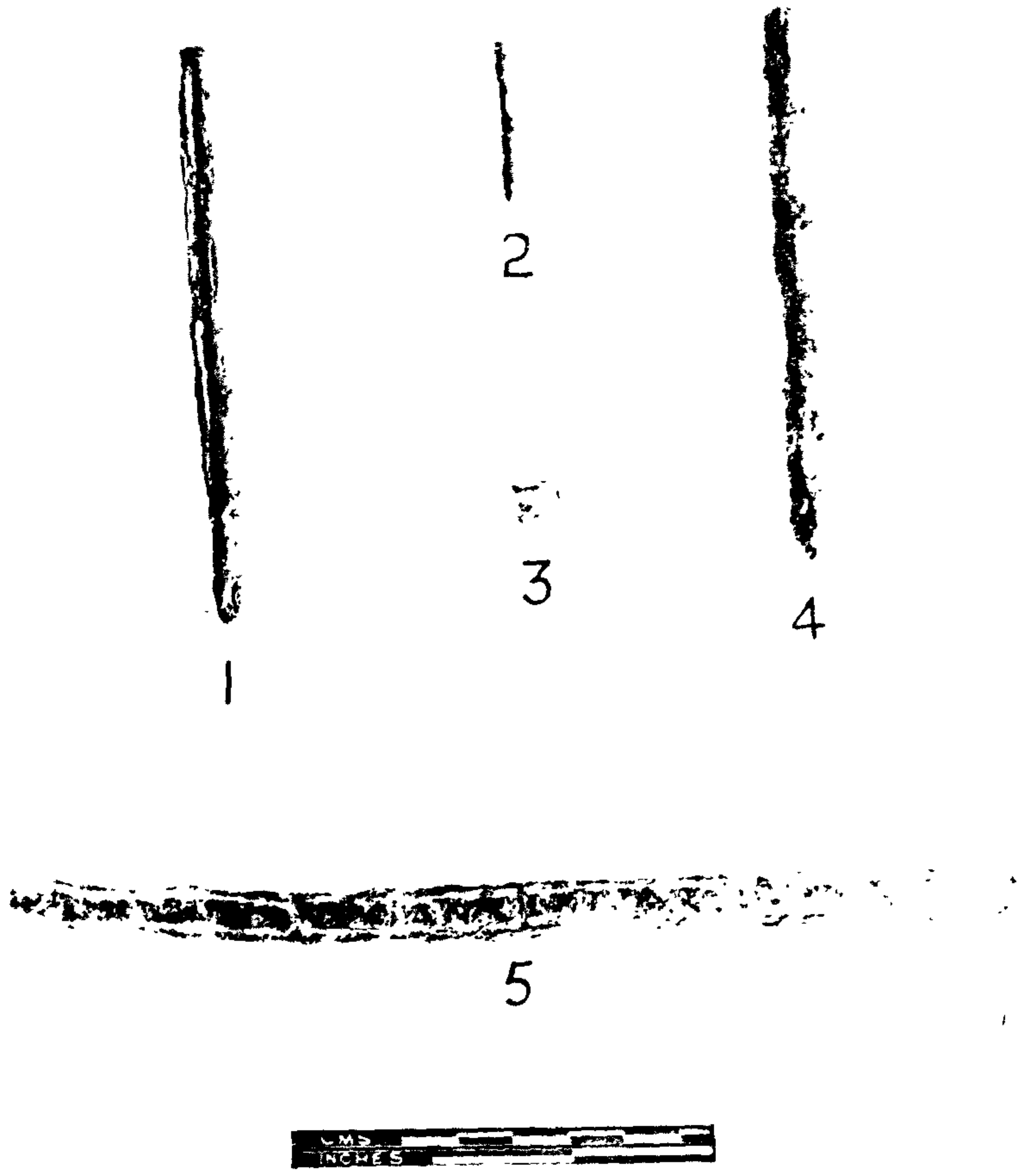
B

A, *Awls and pins (copper and bronze); Period A.* B, *Bronze drills; 1 auger-bit; 2 hollow drill; 3-4 flanged drills Period A. See pp. 521 and 543*

A

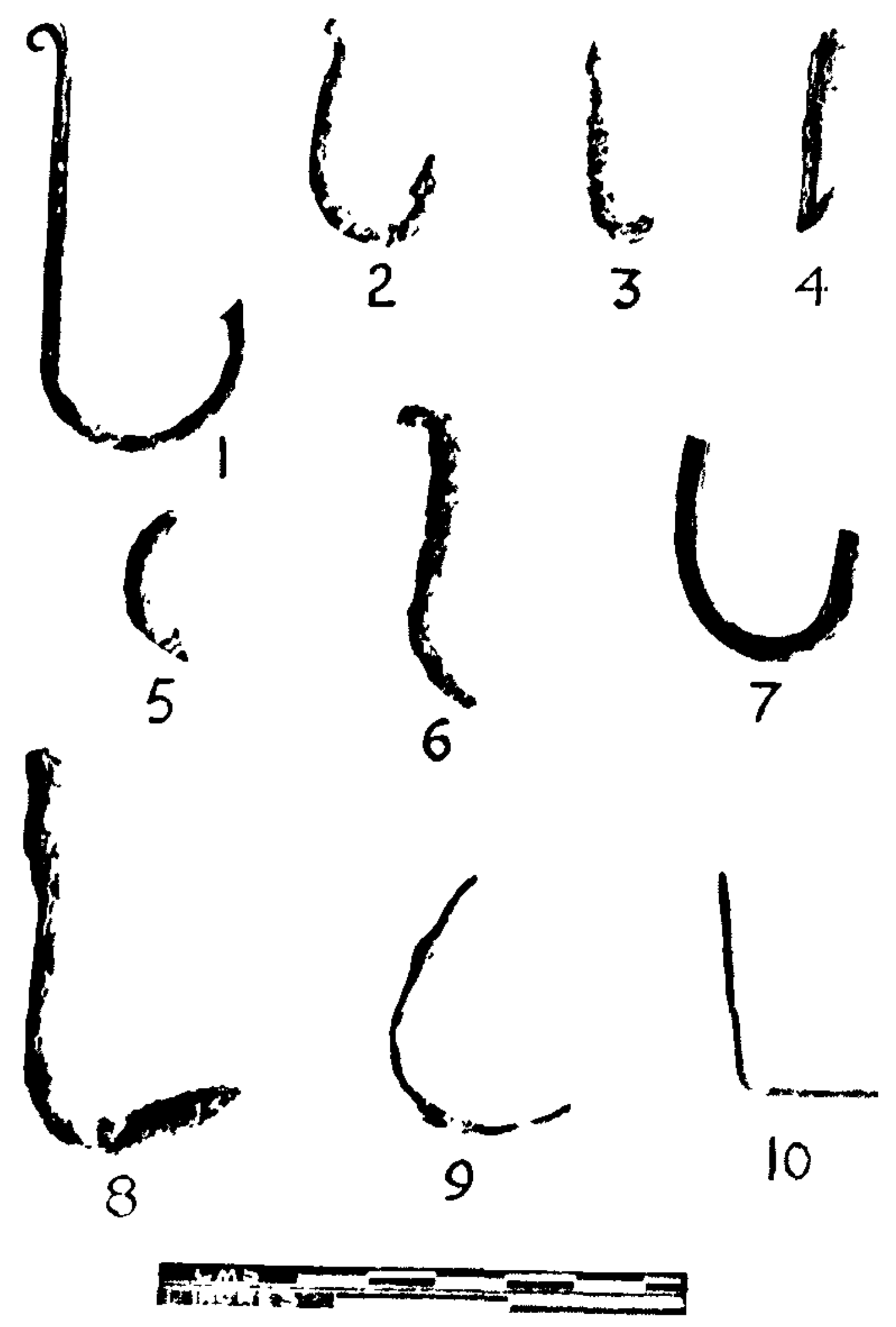


B

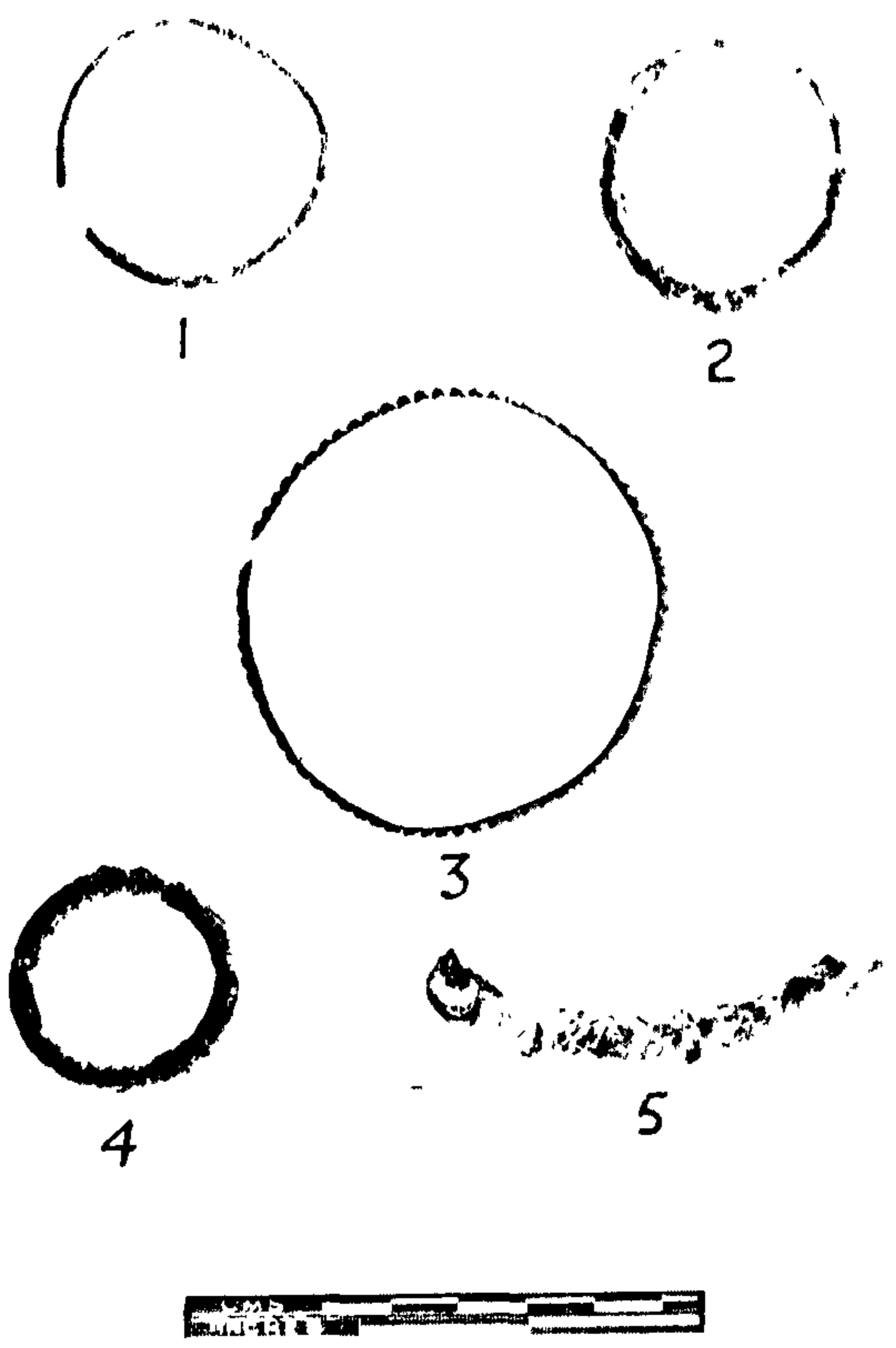


C

A, Planer-bit (copper) Period A; B. Barbed arrow-heads (copper) Period A; C. Nails and rods (copper and bronze) 1-2 and 4 nails; 3 bolt; 5 grooved rod Period A. See pp. 543 and 546

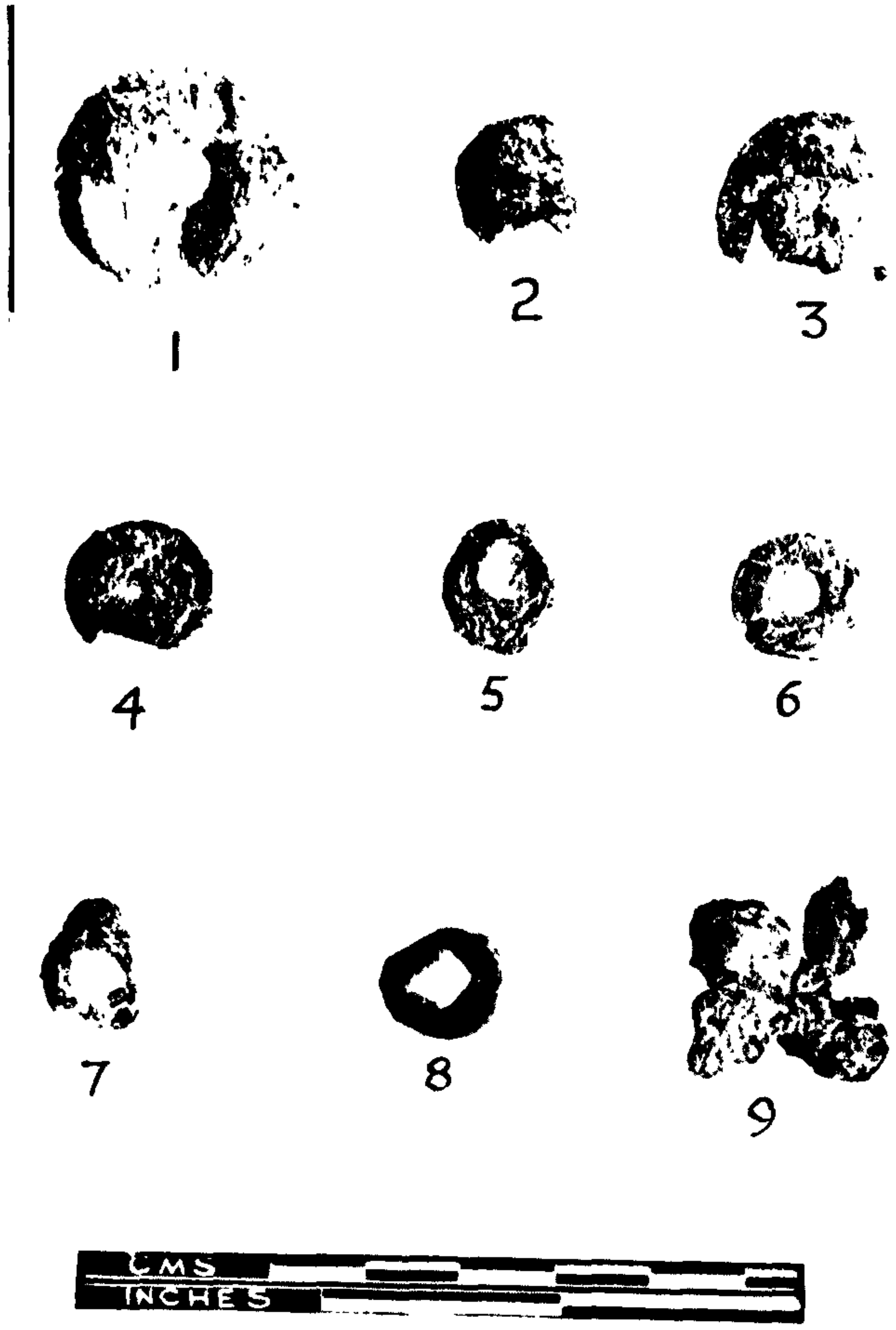


A

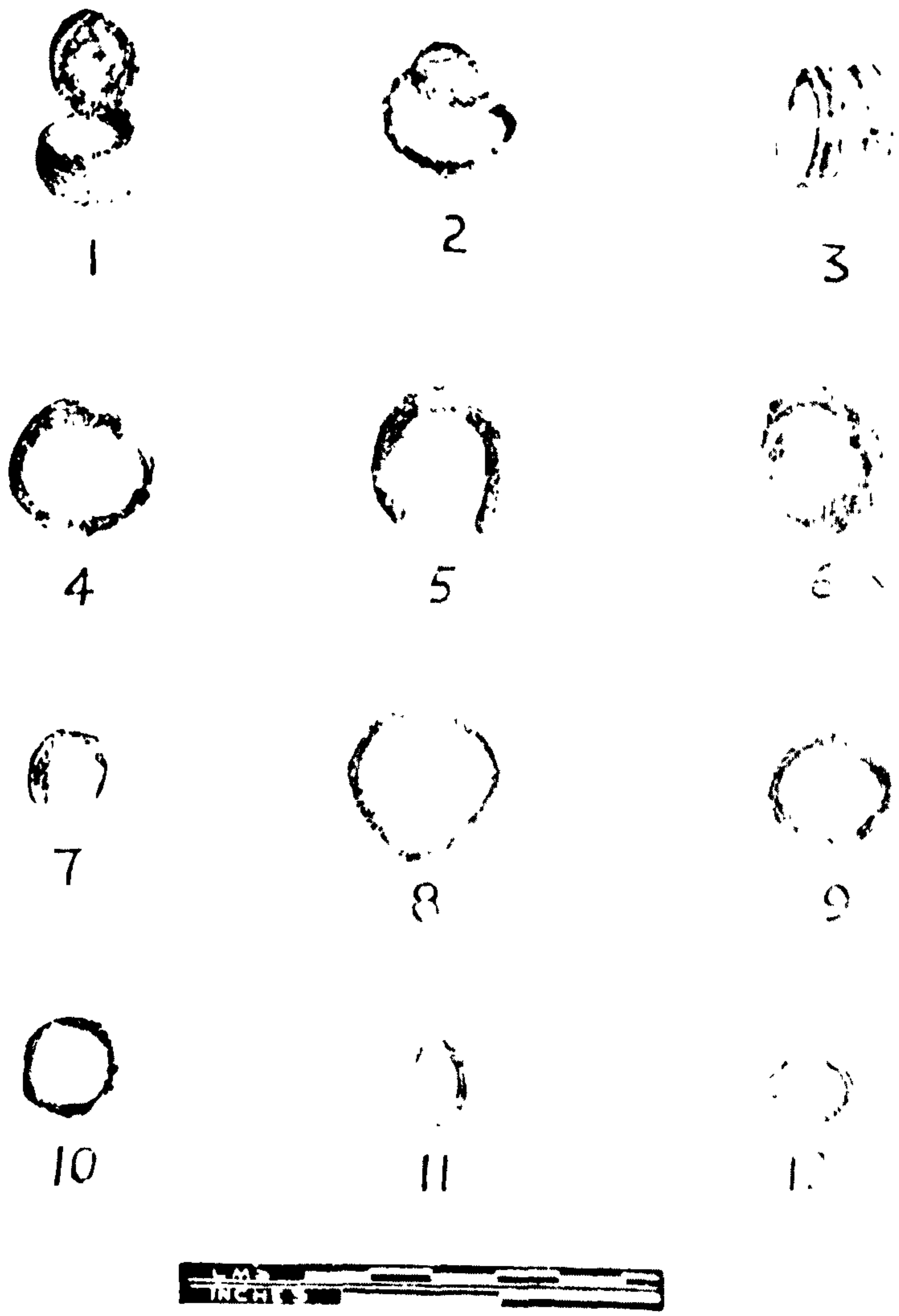


B

A, *Barbed and loop hooks (copper and bronze) Periods A and B*; B, *Bangles (copper and bronze) Period A. See pp. 521 and 546.*

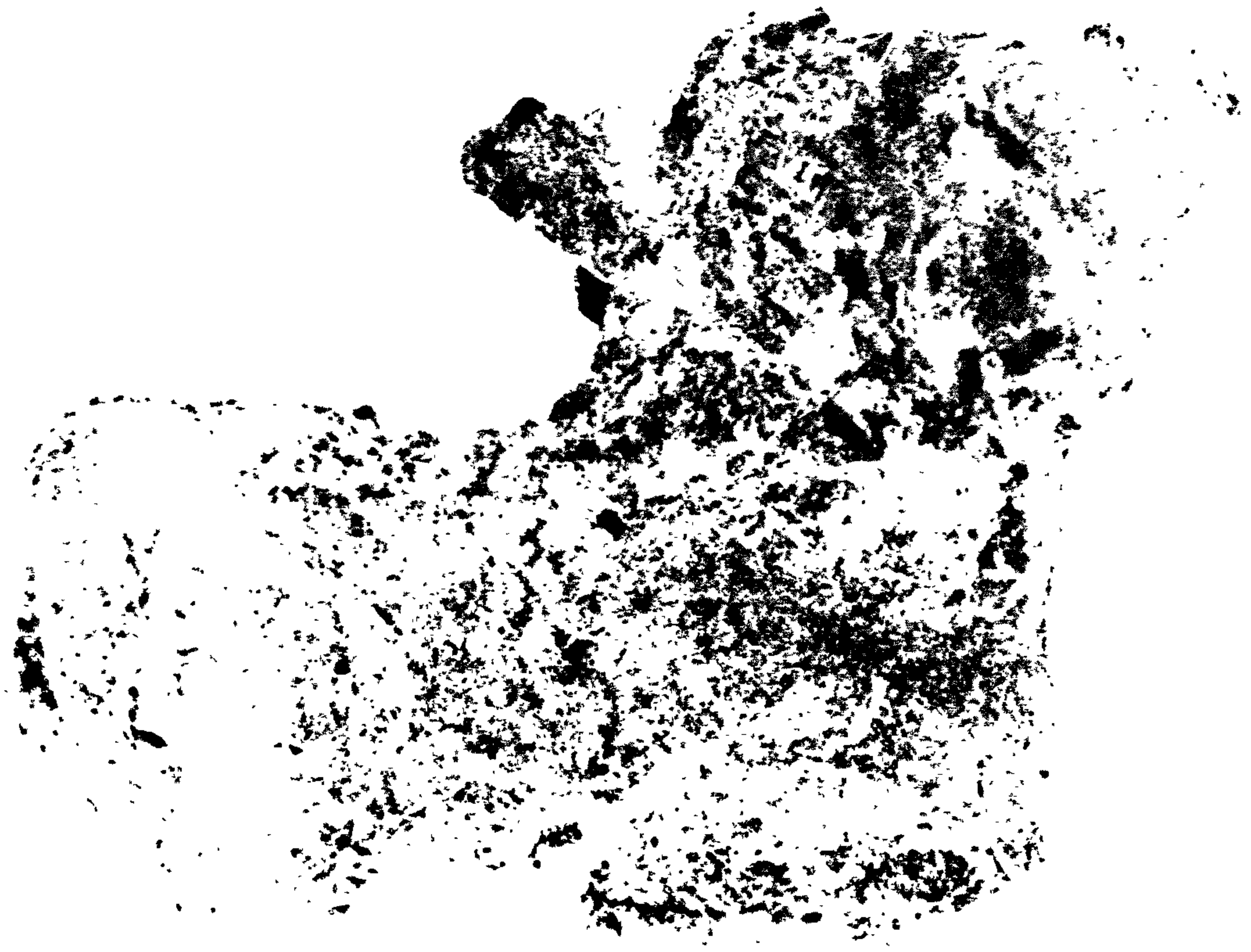


A



B

A, *Ear-ornaments, (copper) Periods A and B* B, *Copper rings; 1-7 coiled, 8-12 plain Periods A and B. See pp.* 534, 546 *and* 549.



A

B

A. *Bull-amulet, copper. Period I. Scale 4:1.* B. *Hare, copper. Period A. Scale 3:1. See pp. 521 and 549*

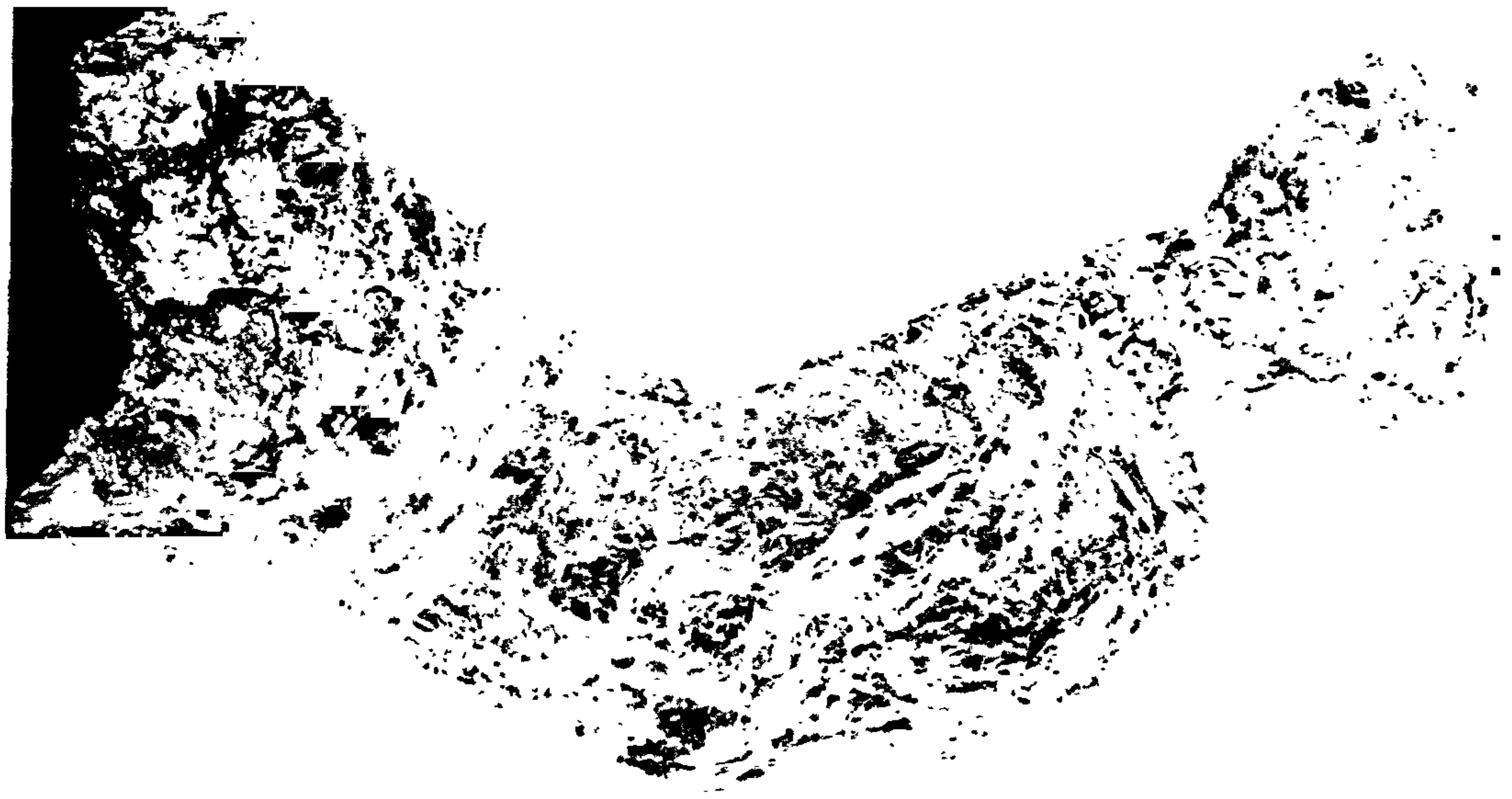
PLATE CCXLIV

A

B

A, *Dog (copper) Period A ; Scale 4/1 ;* B, *Dog (copper) Period A ; Scale 3/1. See pp. 535 and 549*

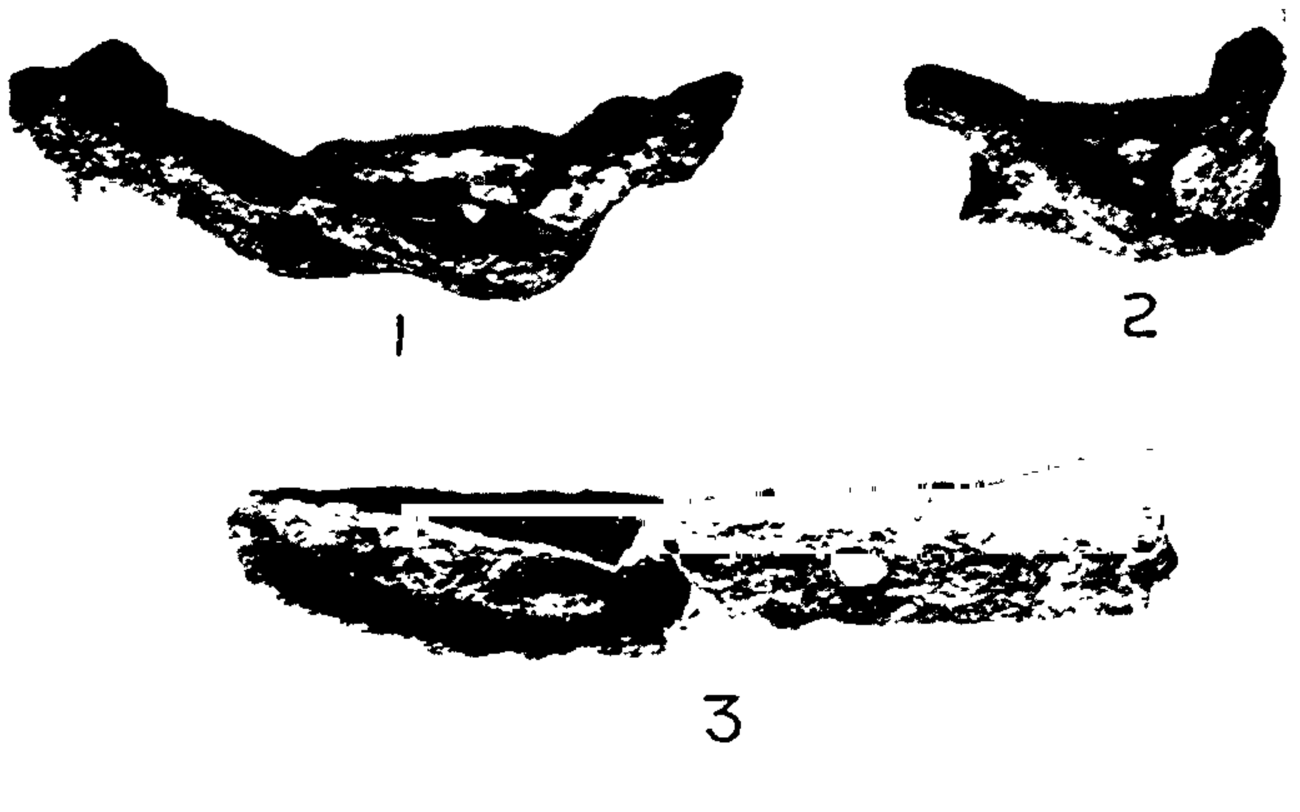
A



B

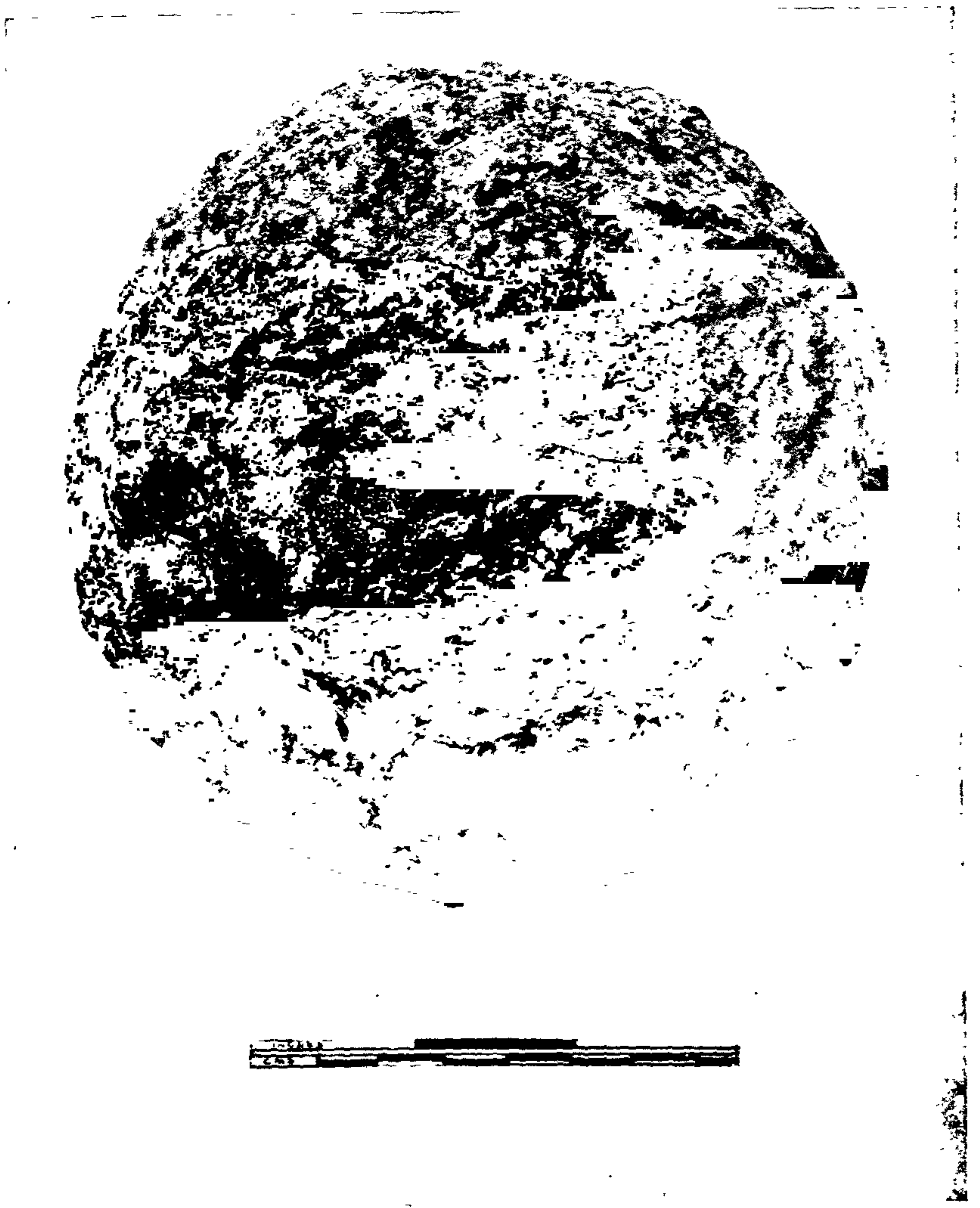
A, *Bird-head of a pin (copper) Period A; Scale 6/1*; B, *Cock (copper) Period A; Scale 2/1.* *See pp. 521 and 552*

A

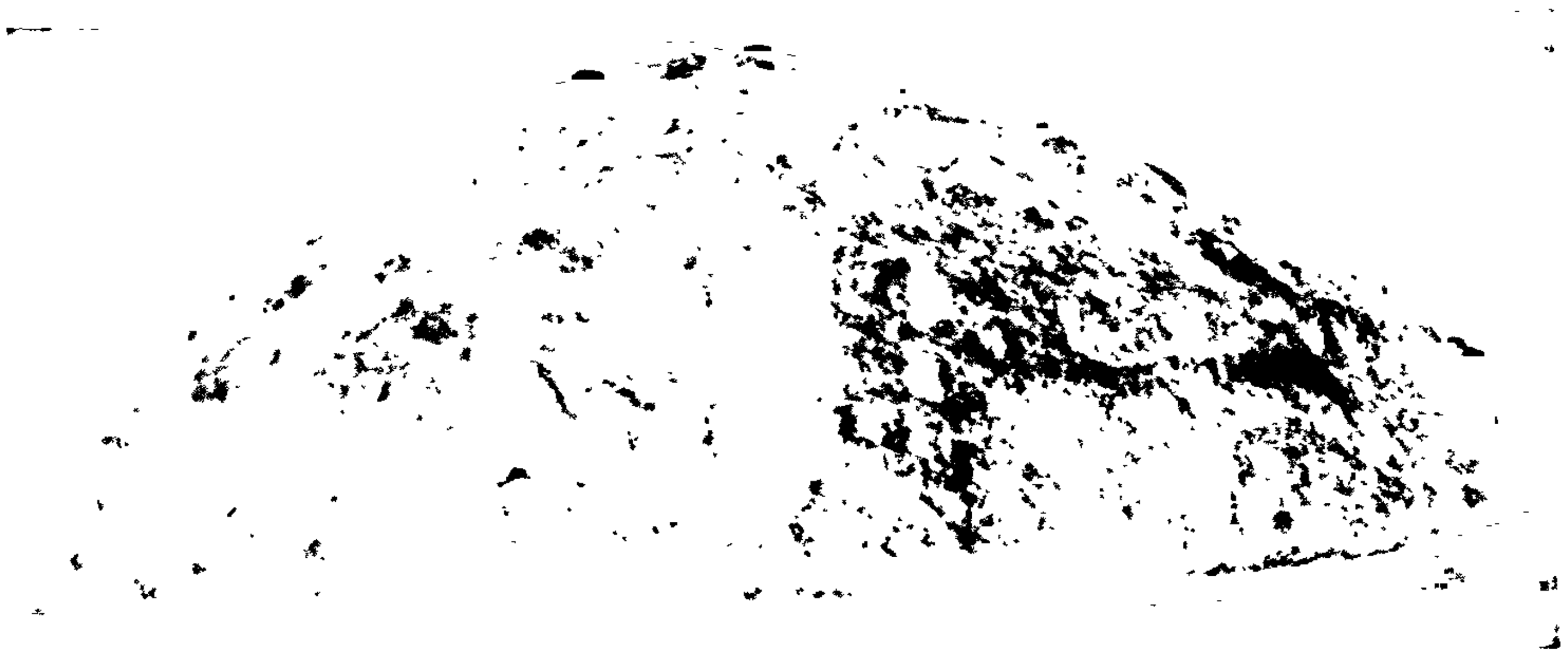


B

A. *Bronze mirror Period A*; B. *3 Spoon 1, 2 chains (copper and bronze) Period A*; *Scale 1/1*.
See pp. 536 and 552



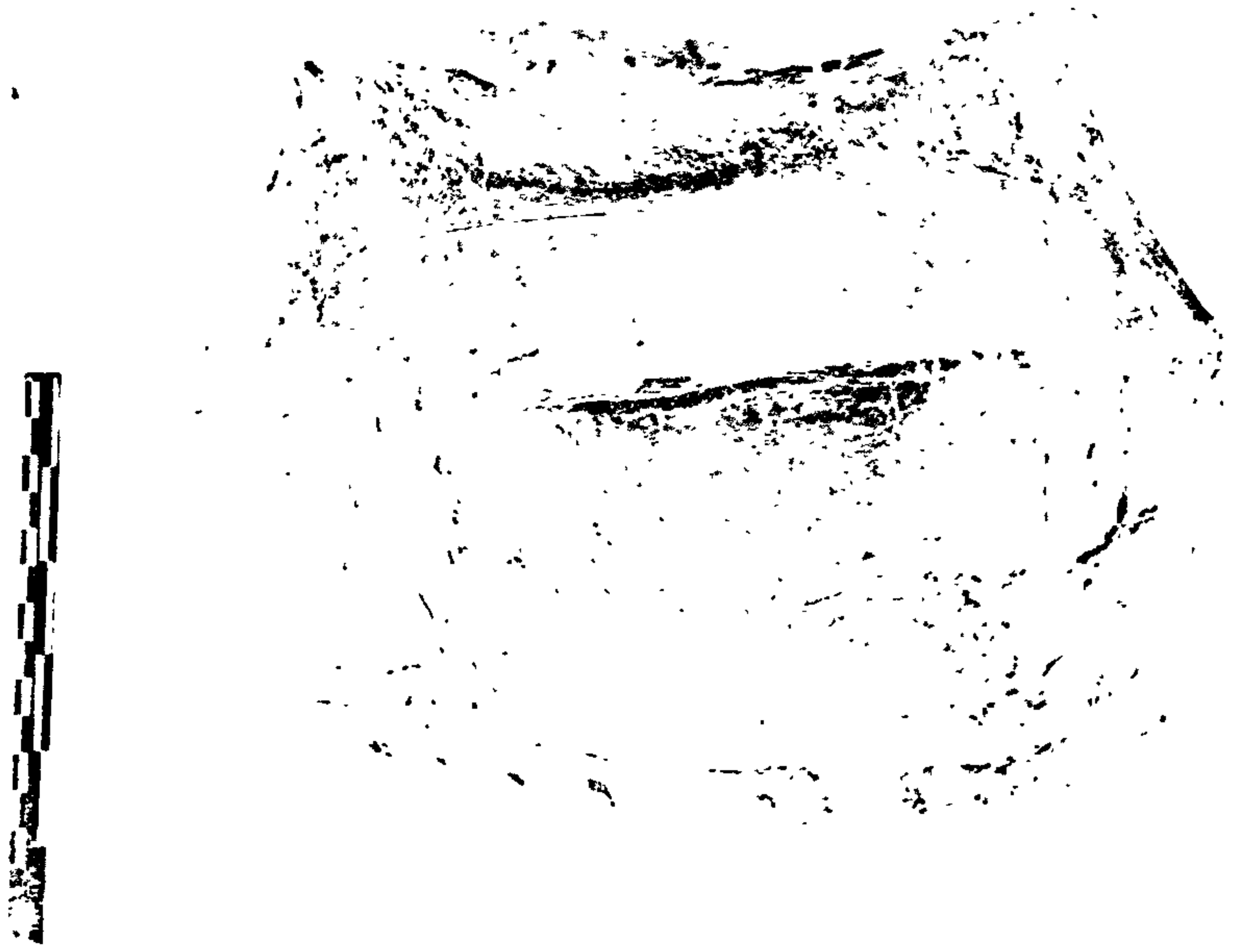
A



B

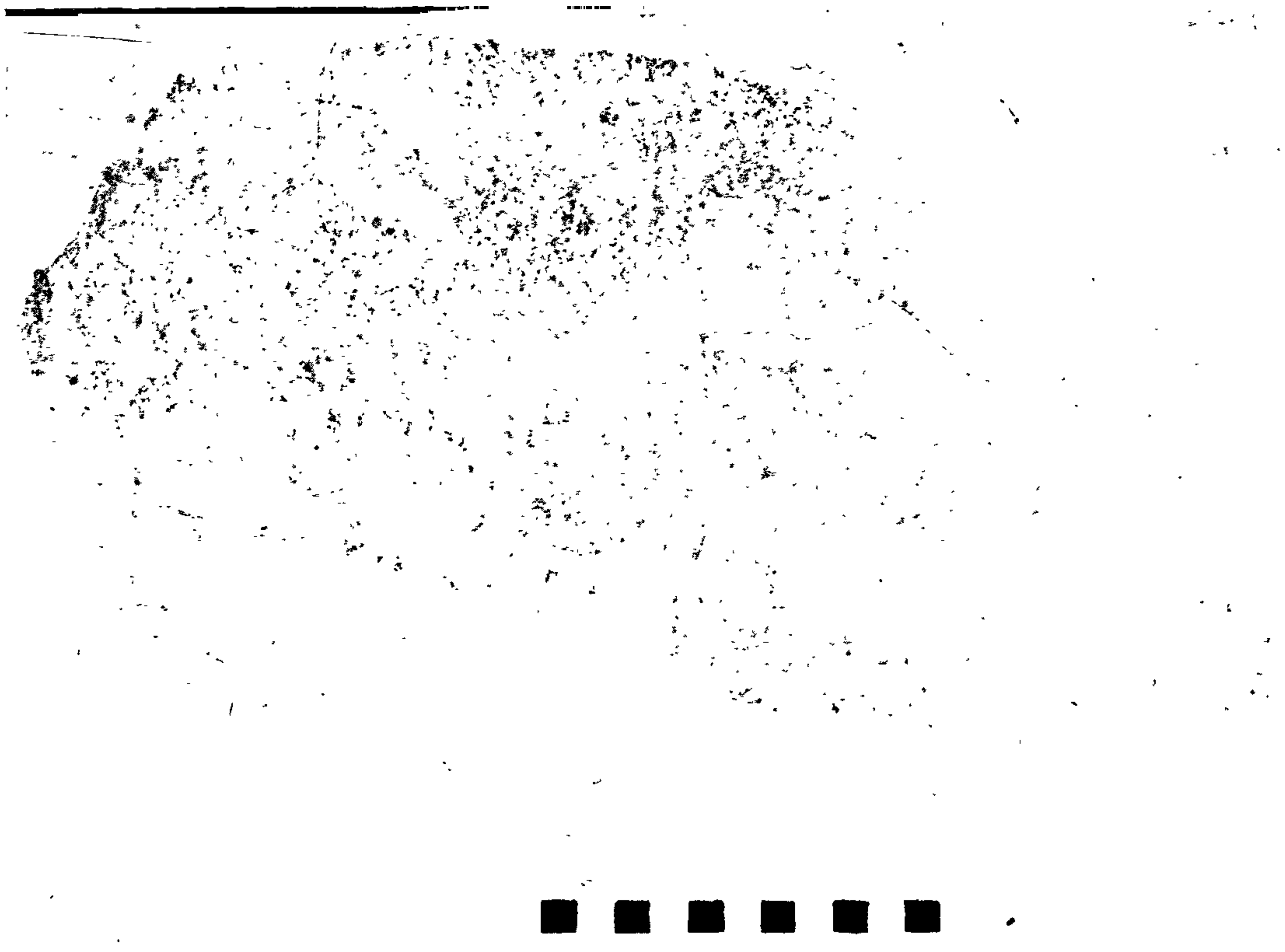
A, *Bun-ingot (copper) from Susa Period A (Top view)*: B, *side view*.
See pp. 520 and 552

A



B

A. *Copper Bun-ingot from Lothal (side view) Scale 1:1*; B, *Revetted jar (copper) Period A. See pp. 520, 536 and 552*

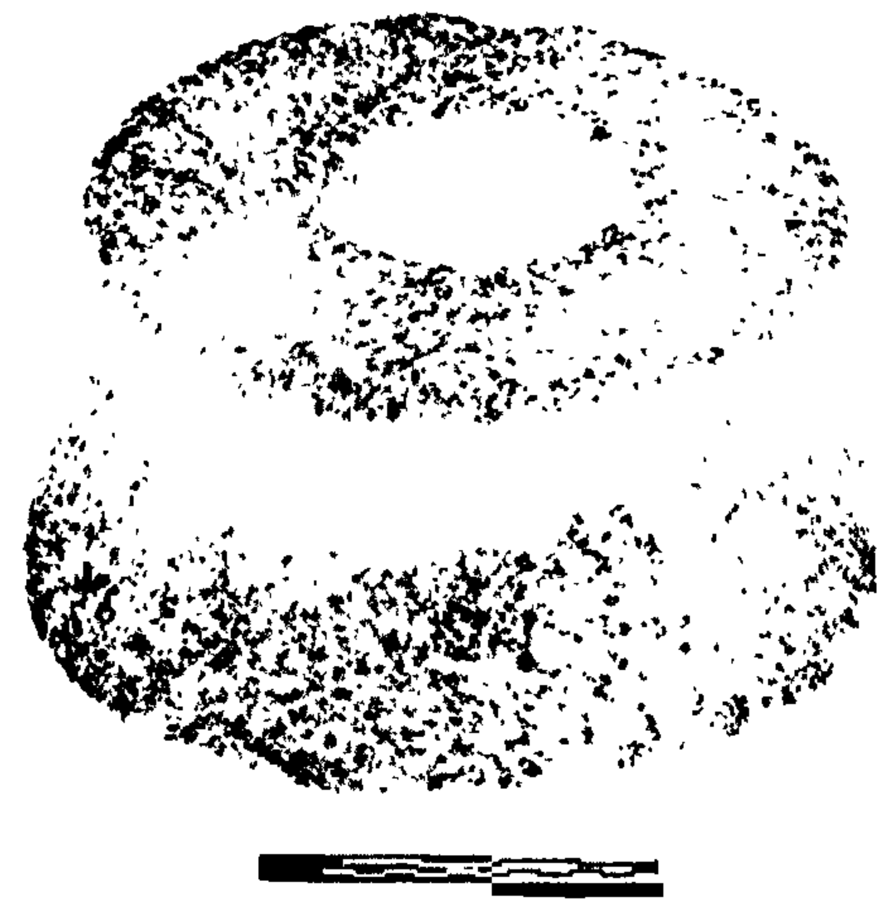


A

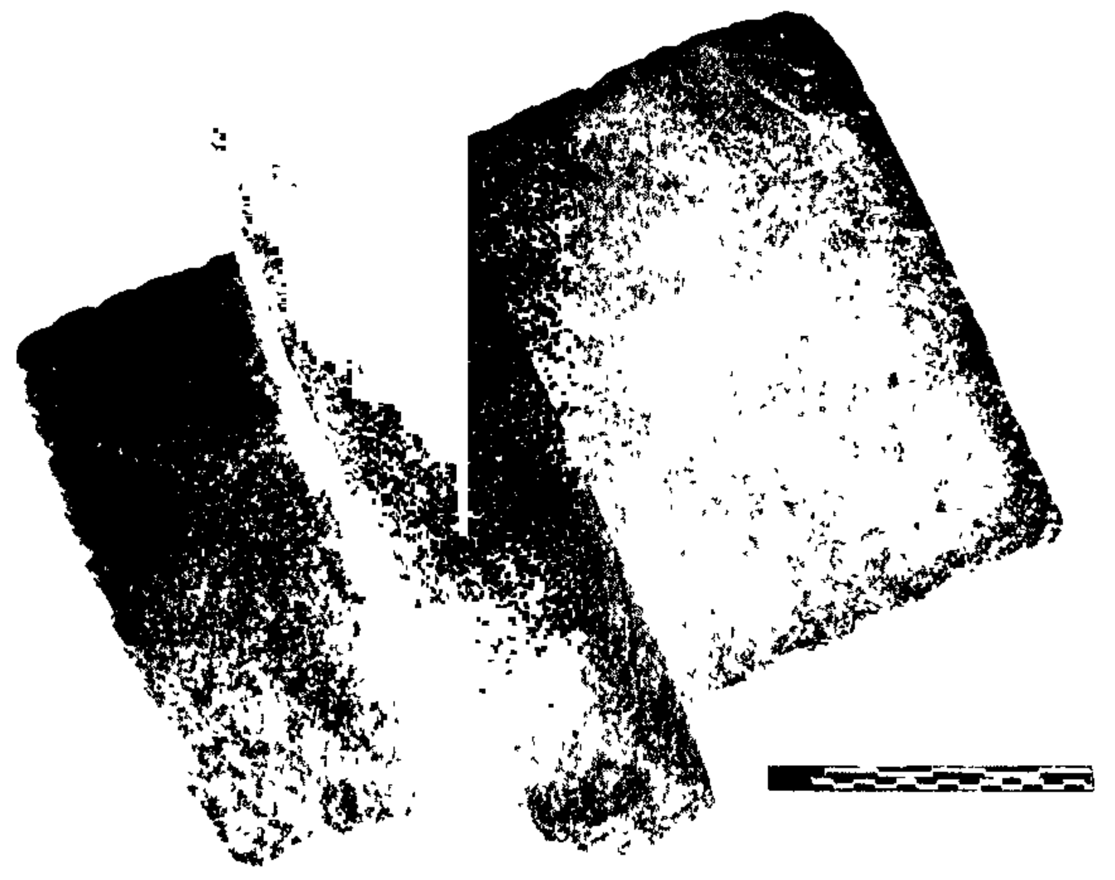
B

A, *Corroded copper sheet from a smithy Period A* ; B, *Use of a bronze auger-bit from Lothal in a modern bow-drill.* *See pp. 522, 532 and 552*

PLATE CCL



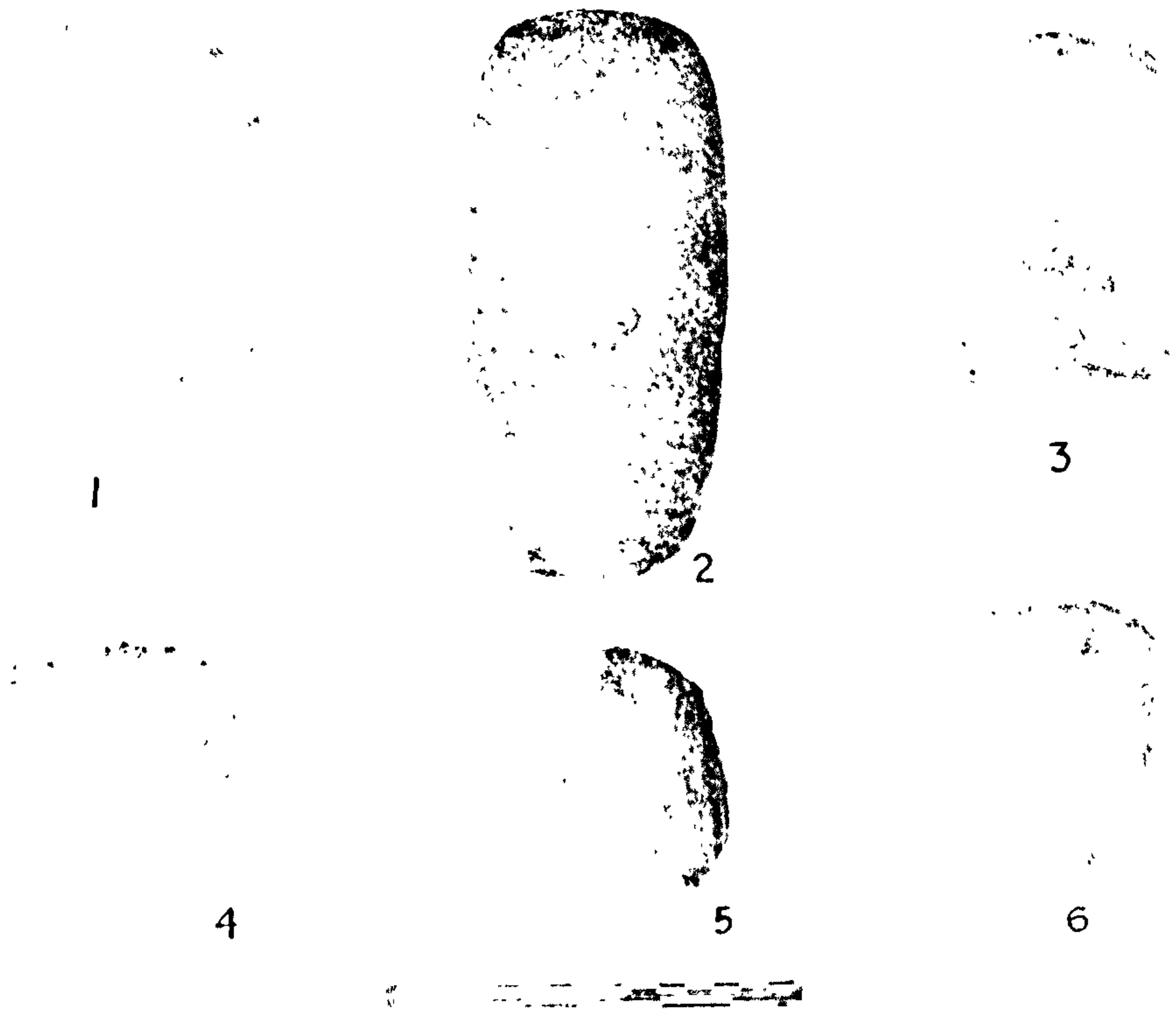
A



B

C

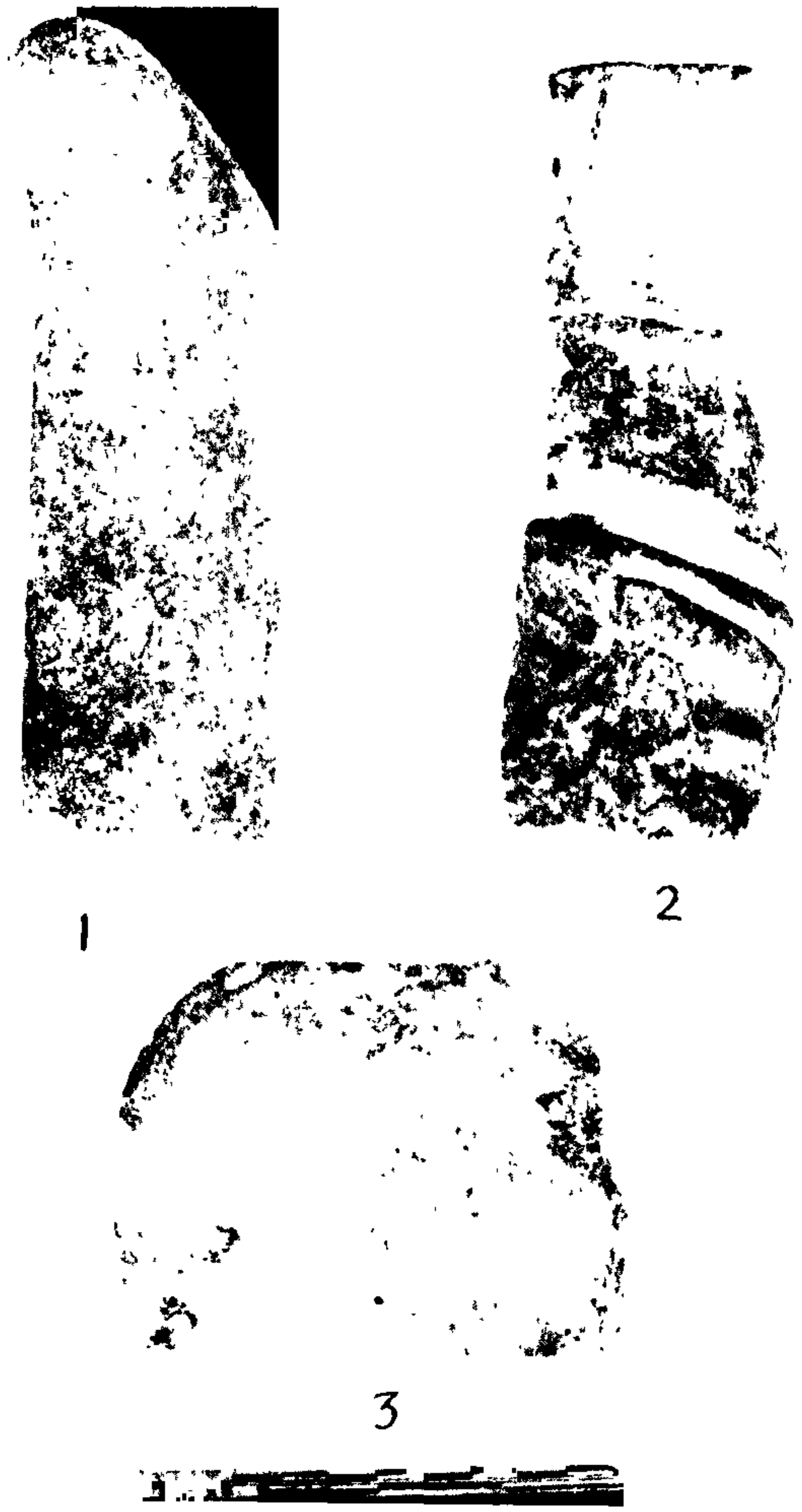
A, *Upper half of a rotary mill (granite) Period B*; B, *Pedestalled quern and muller (sandstone) Period A*; C. *Saddle quern (sandstone) Period A. See pp. 555, 556 and 566*



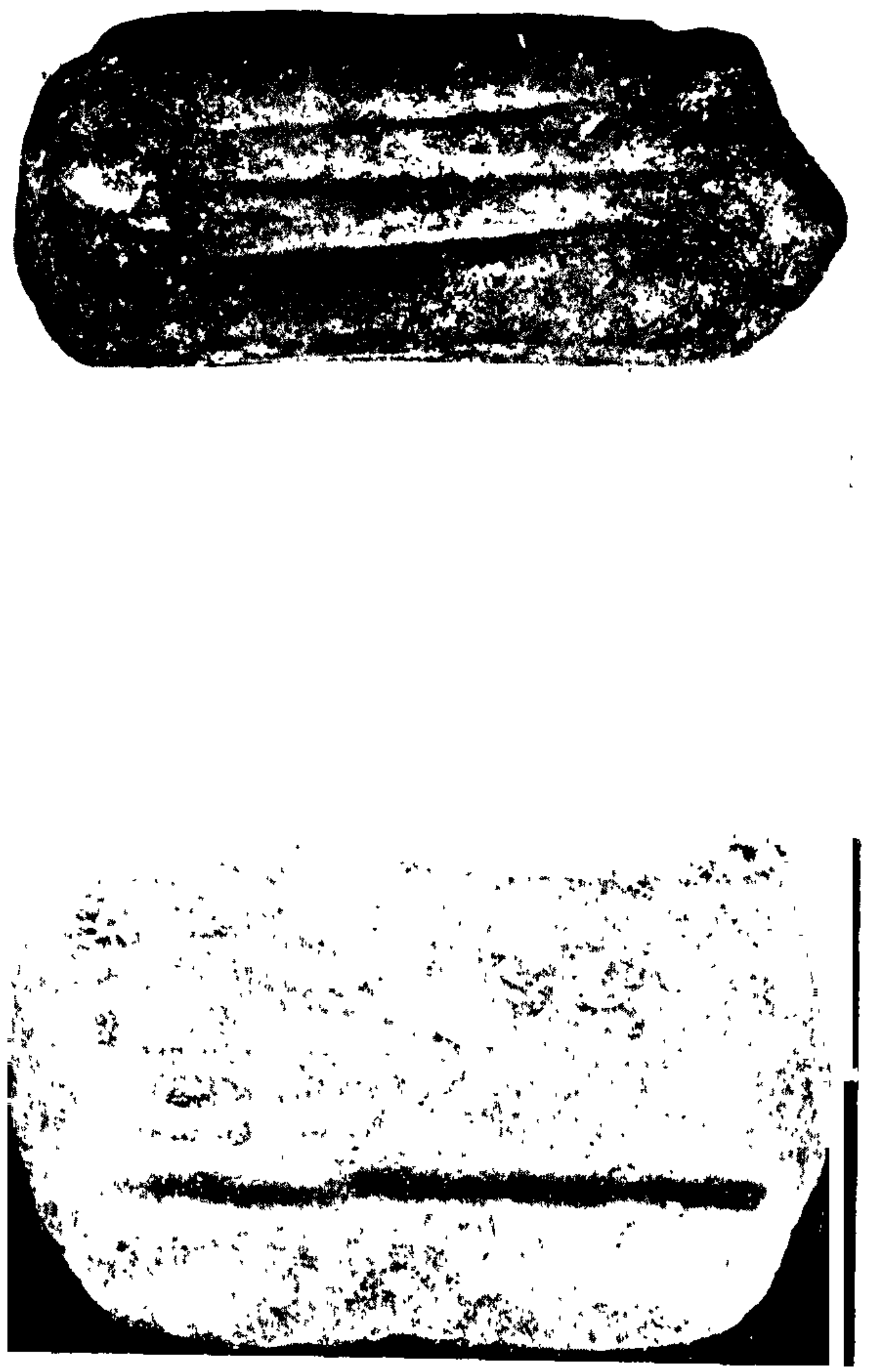
A

B

A. *Stone mullers Periods A and B*; B. *Stone pounders Periods A and B. See pp. 556 and 566*

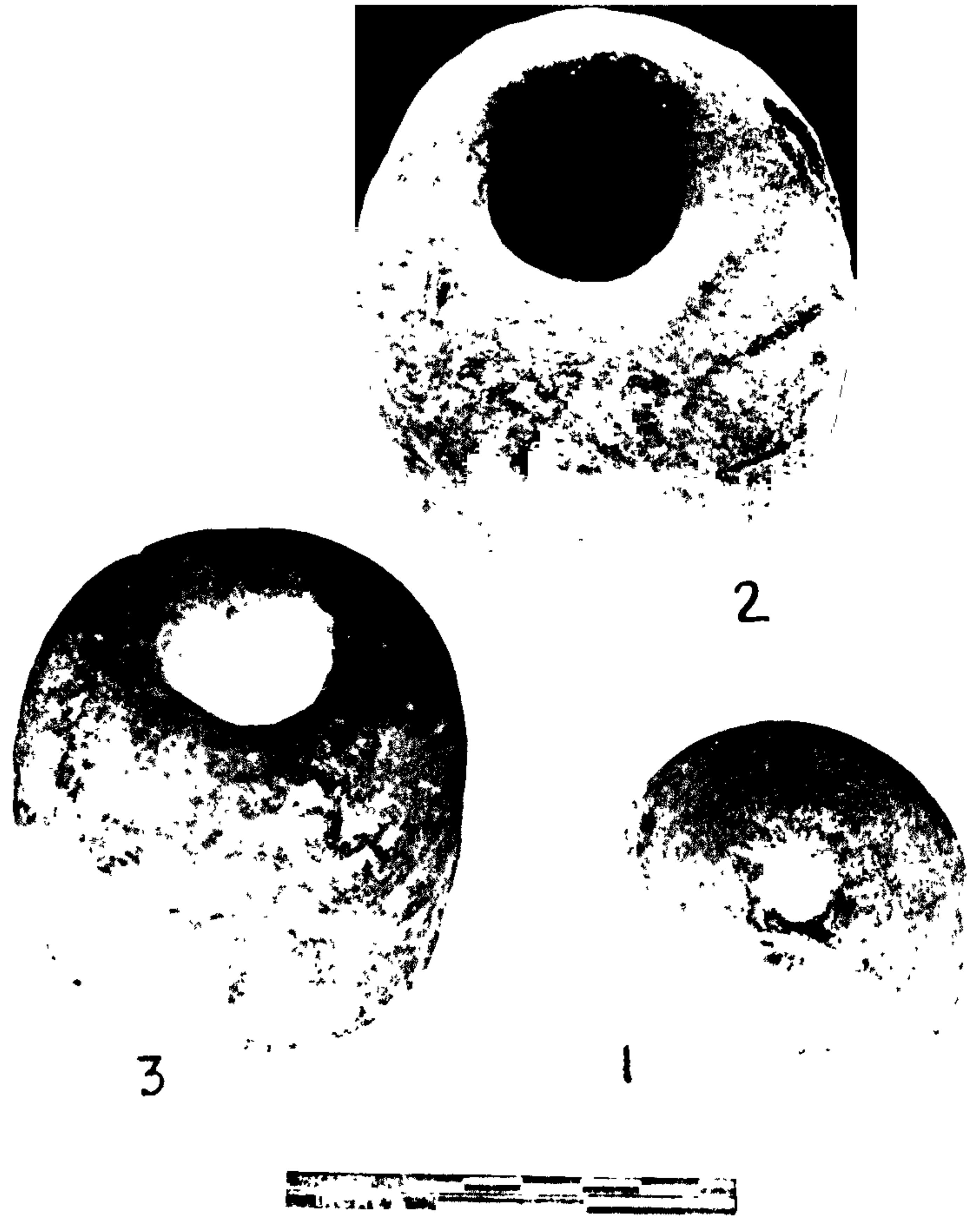


A

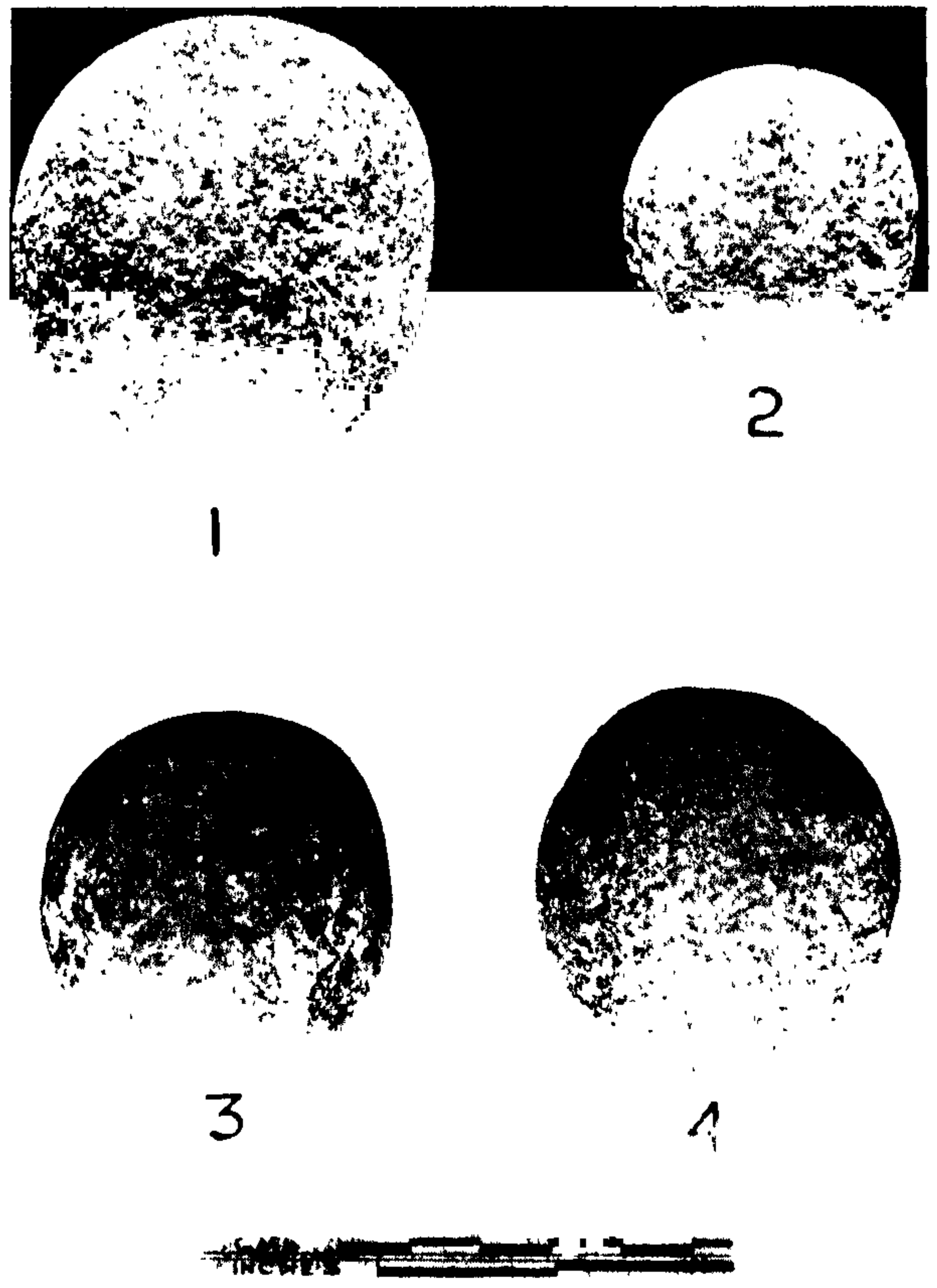


B

A, *Whetstones Period A*; B, *Stone moulds for awls pins etc. Period A. See pp. 557 and 568*

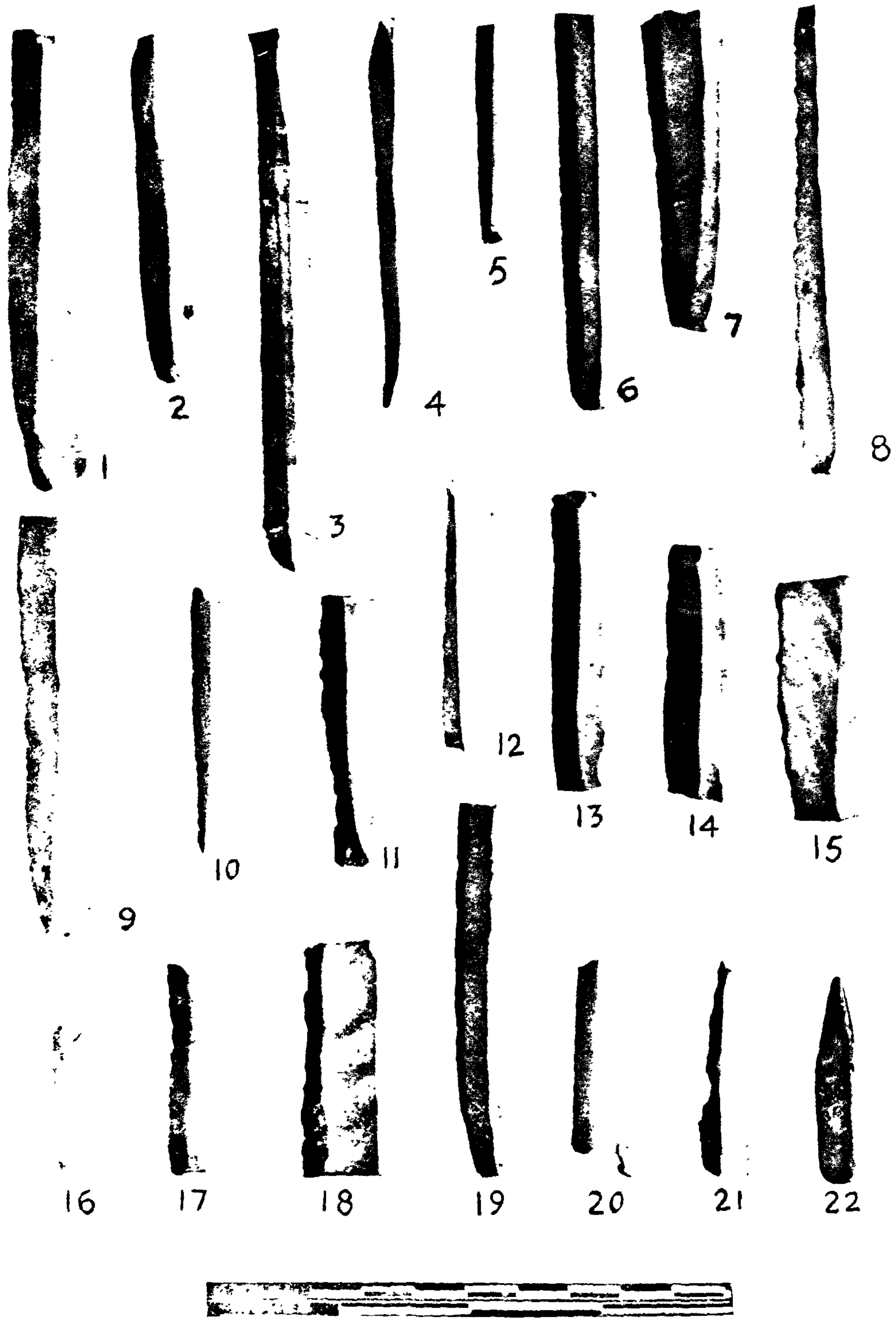


A

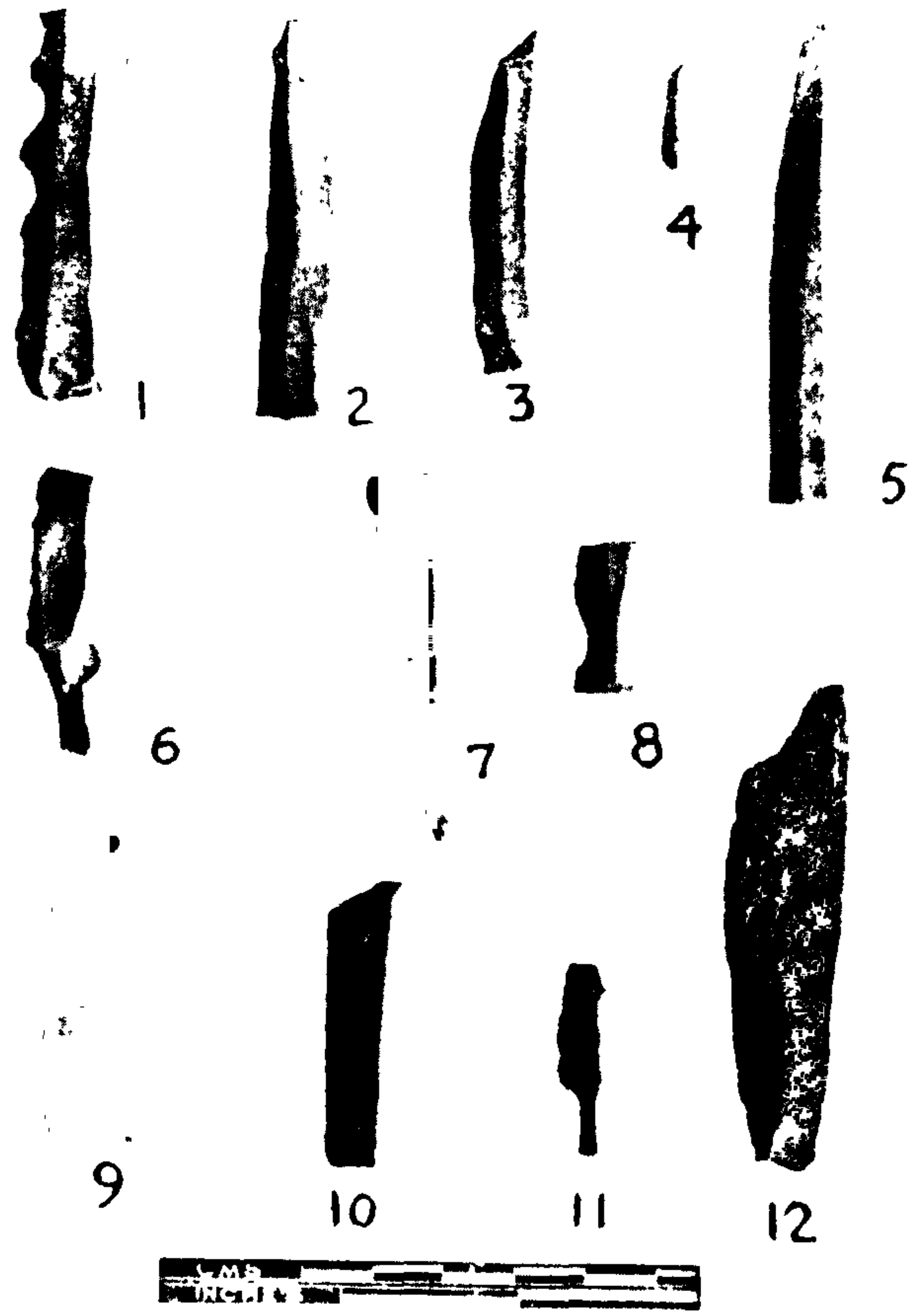


B

A, *1 Stone crucible 2 maceheads Period A*; B, *Sling balls (stone) Periods A and B. See pp. 557 and 568.*



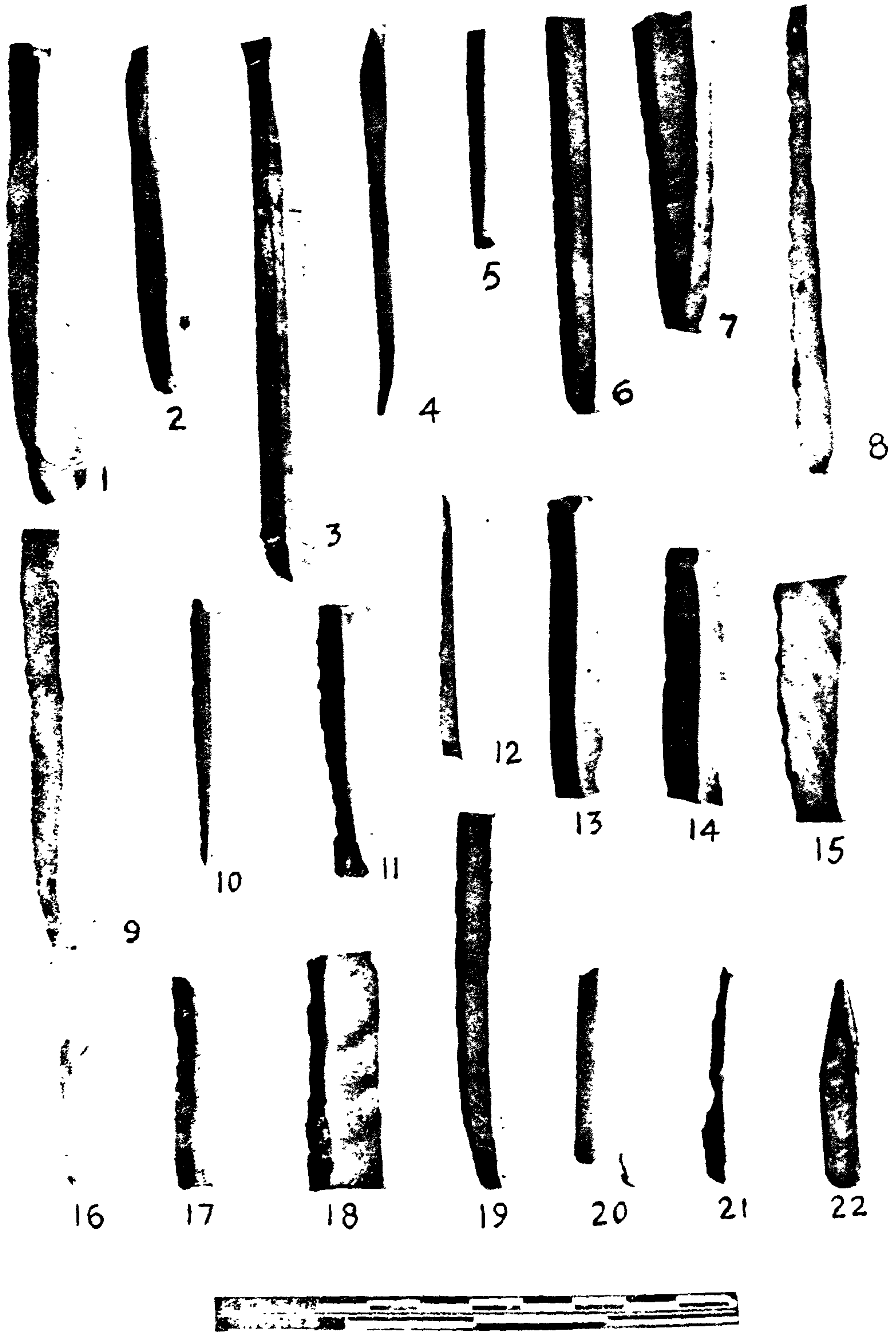
Parallel-sided blades of chert Period A. *See pp. 558 and 568*



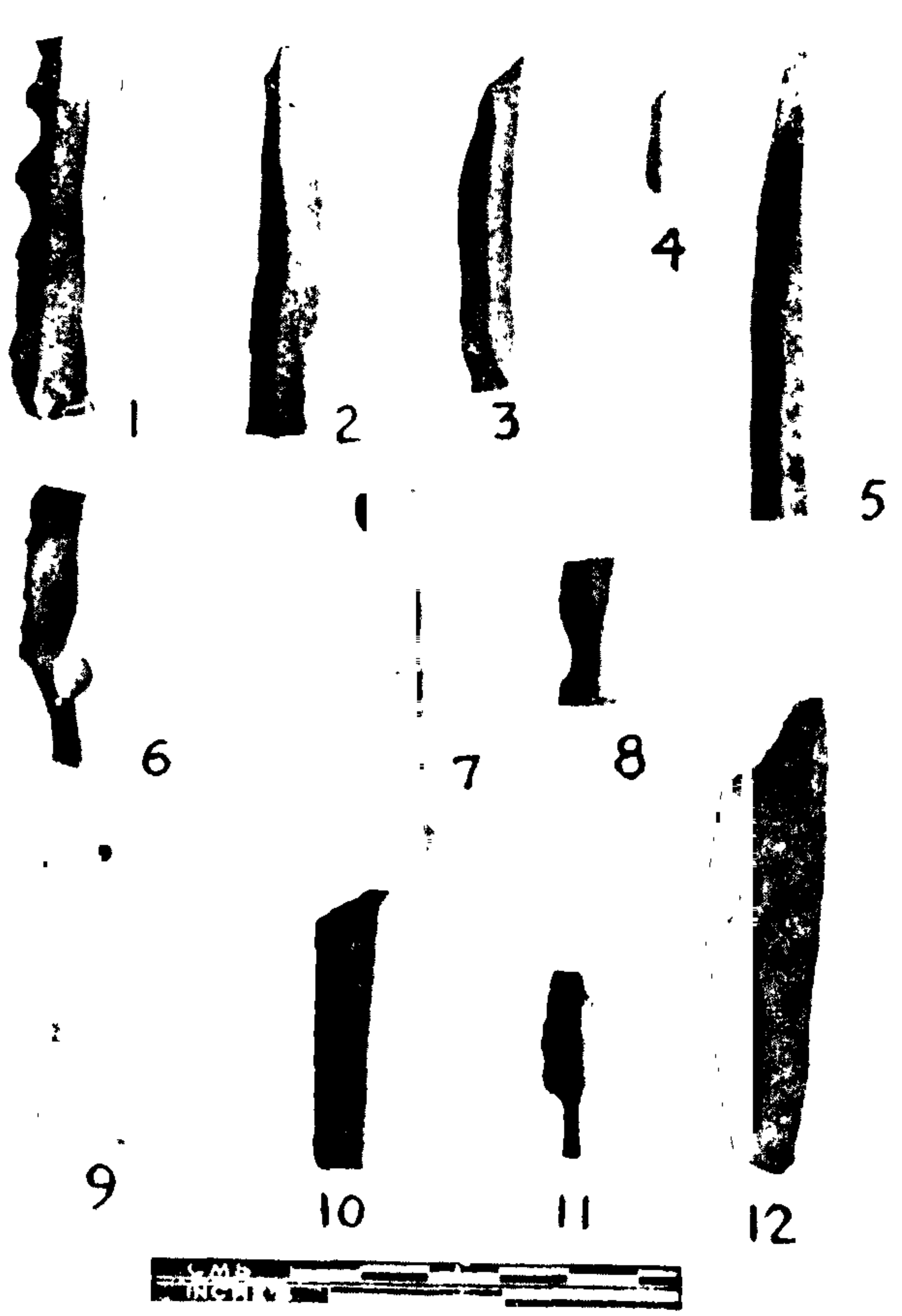
A

B

A, *Parallel-sided blades of chert (serrated, notched, tanged etc.) Period A*; B, *Assymmetrical flakes of flint and chert Period A.* *See pp.* 544, 558, 572 *and* 624



Parallel-sided blades of chert Period A. See pp. 558 and 568

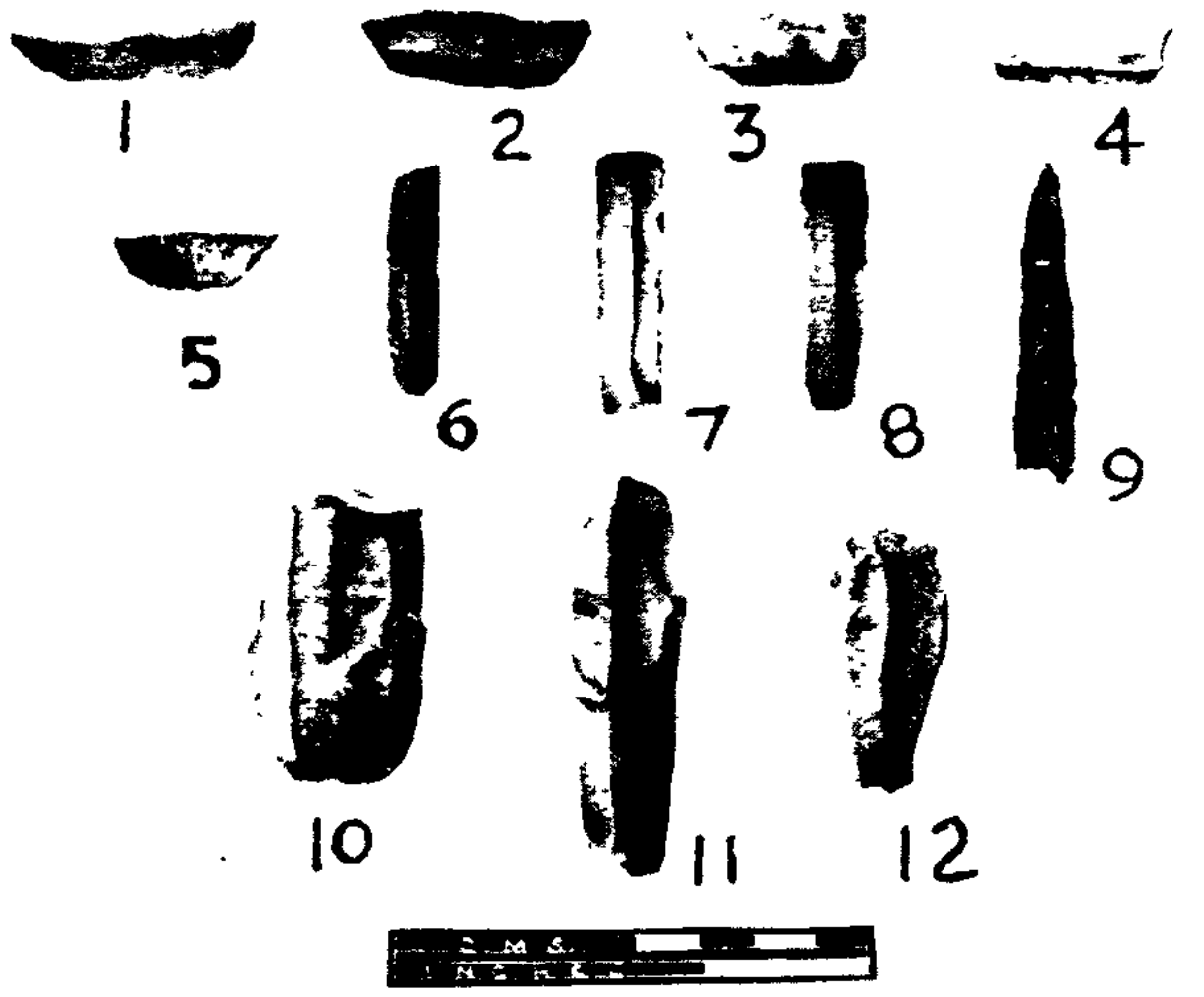


A

B

A, *Parallel-sided blades of chert (serrated, notched, tanged etc.) Period A*; B, *Assymmetrical flakes of flint and chert Period A*. *See pp.* 511, 558, 572 *and* 624

PLATE CCLVI



A

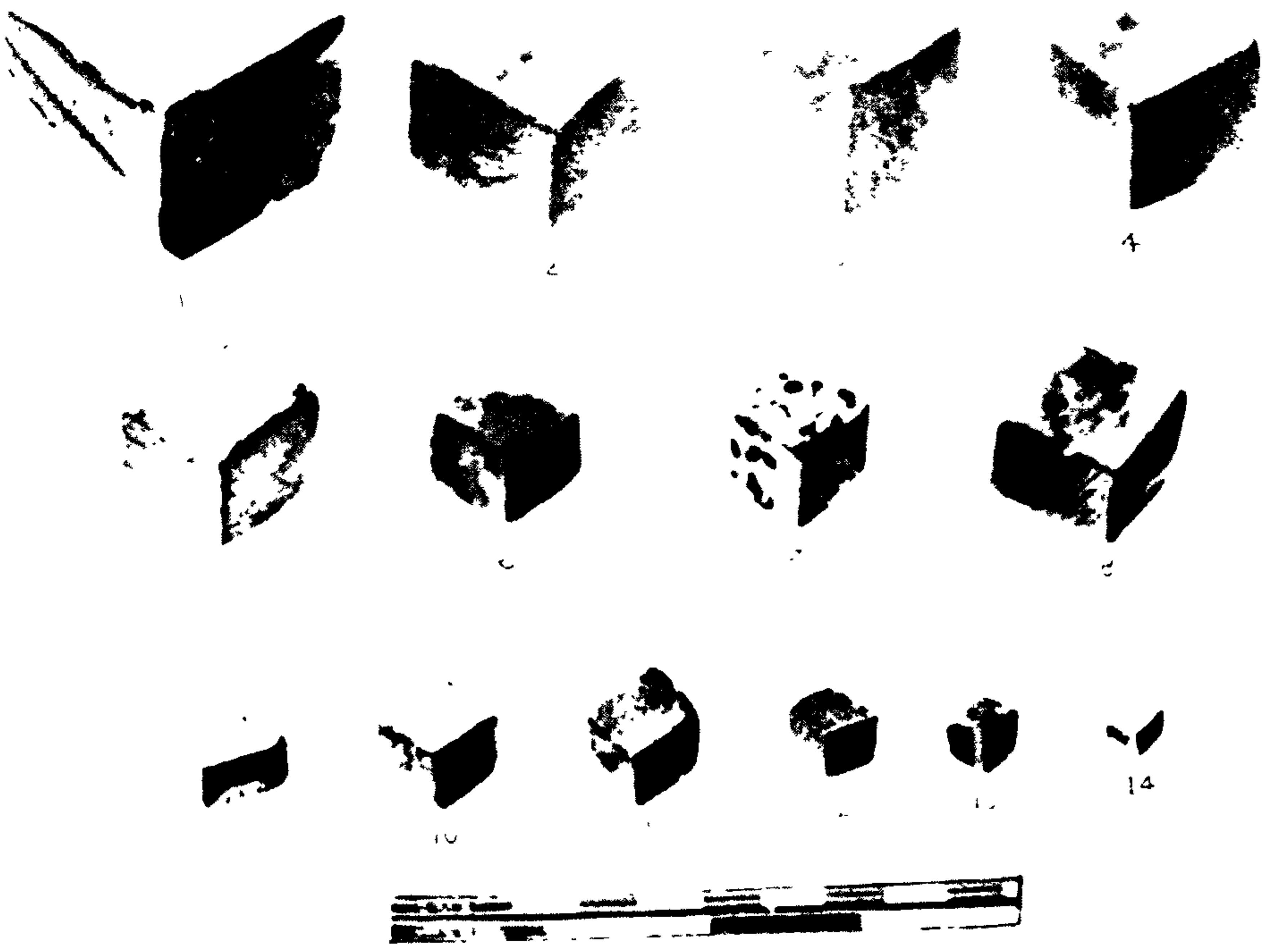
B

13

C

A, *Crescents ; short blades ; cores etc. Period B ; (jasper, chalcedony etc.)* ; B, *Stone chisel (agate) Period A* ; C, *Flake (chert) with crested ridge Period B ; Scale 1 1.* *See pp. 574 and 575*

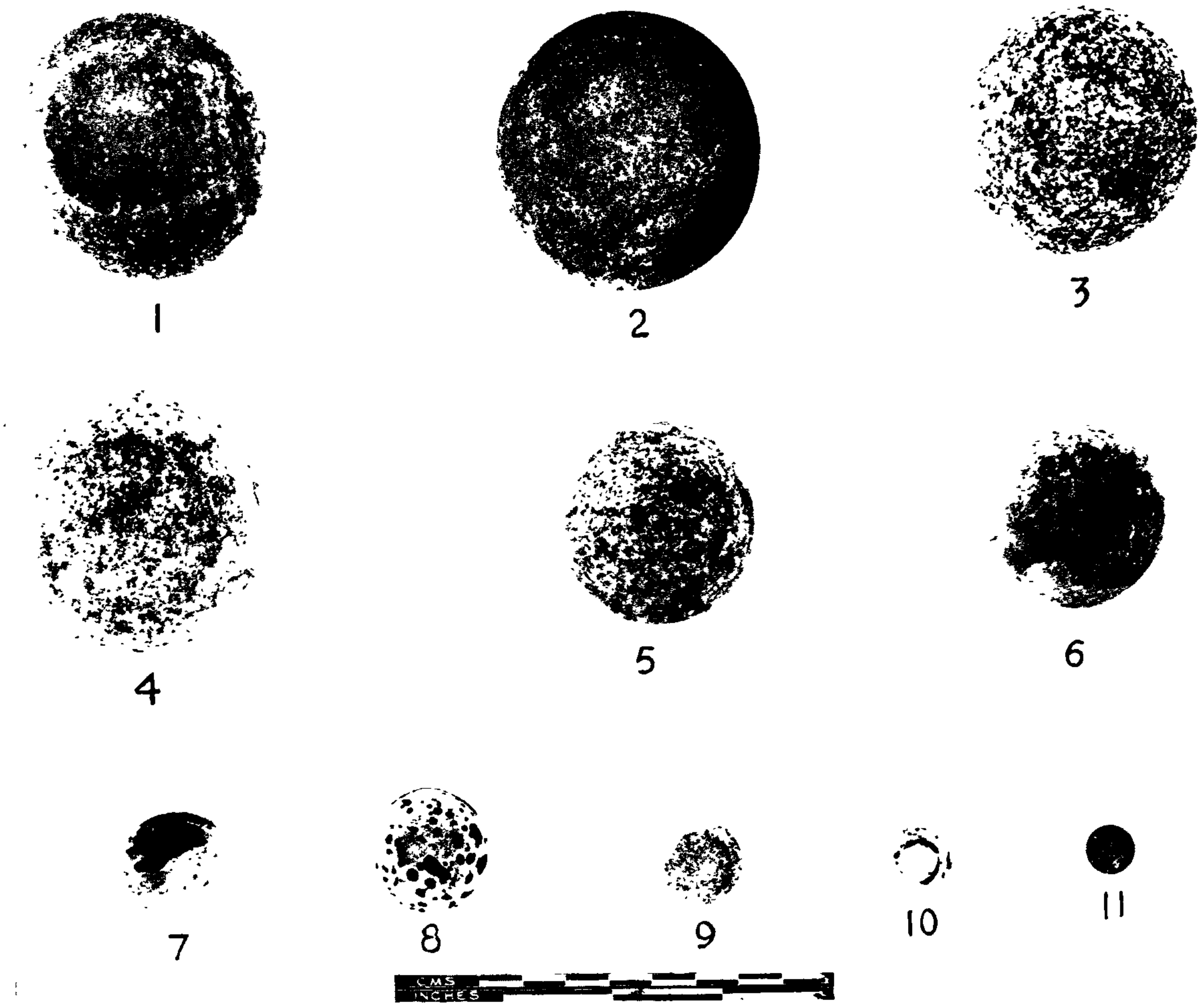
A



B

A. 1 Stone bowl 2-3 and dishes 1 Schist: 2 Syenite: 3: Gneiss Period A: B. *Cubical of agate: chert etc. Period A. See pp. 556, 550ff and 575ff*

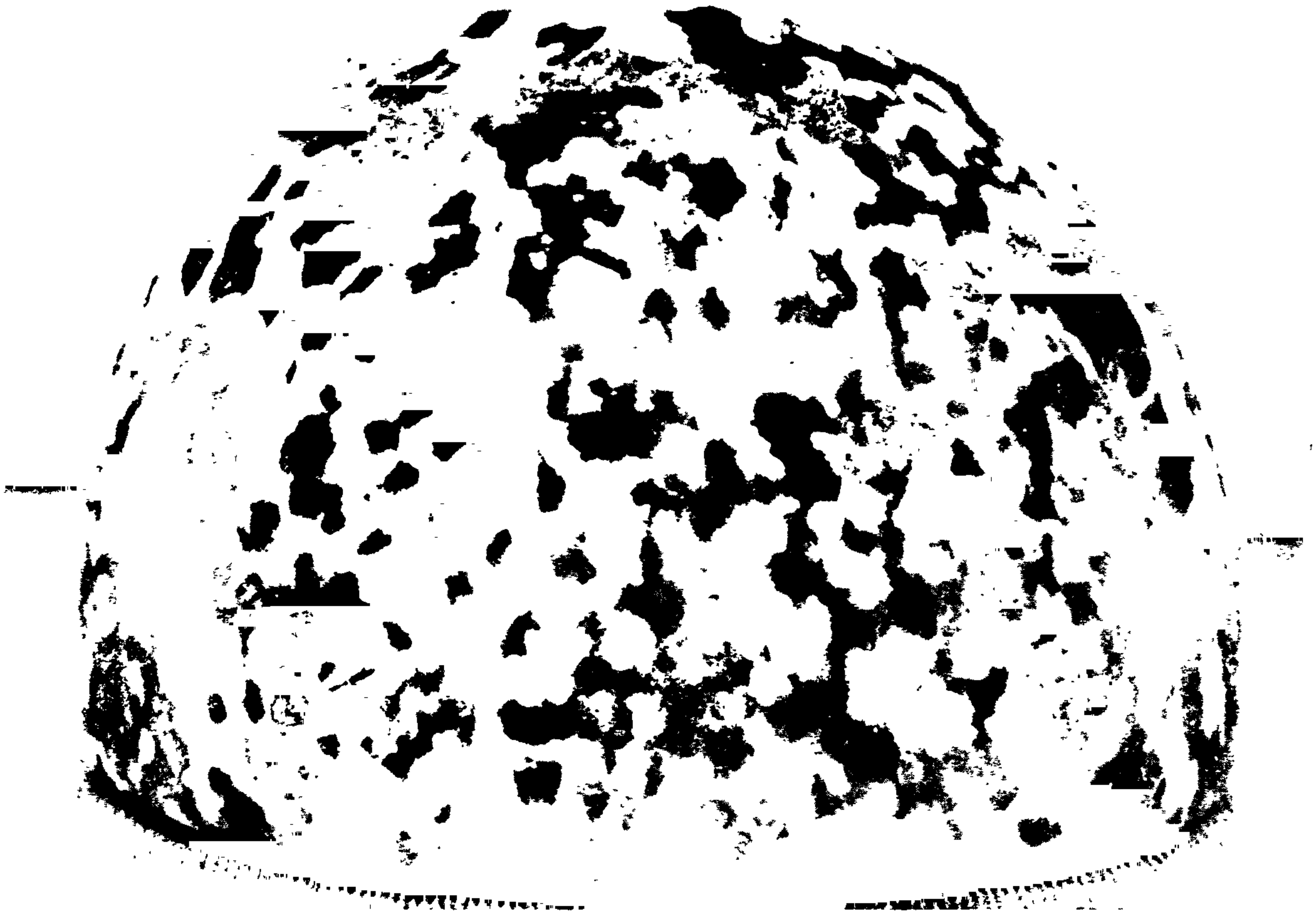
PLATE CCLVIII



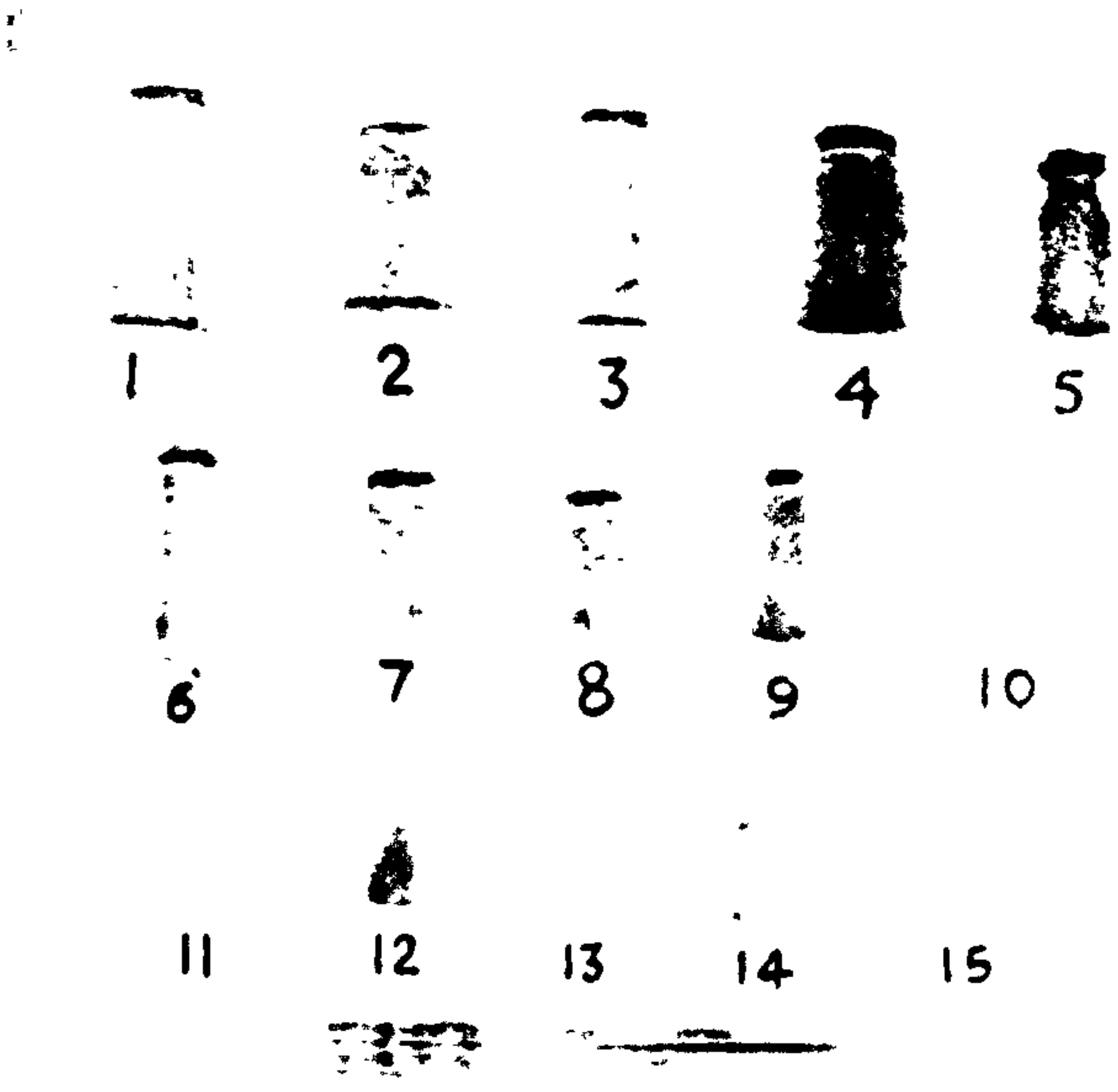
A

B

A, Truncated spheroid weights (stone) Periods A and B; B, Conical stone weights Period A. See pp. 560ff and 577



A



B

A, [illegible] Period I [illegible] B, Cones with button head [illegible] Period [illegible]

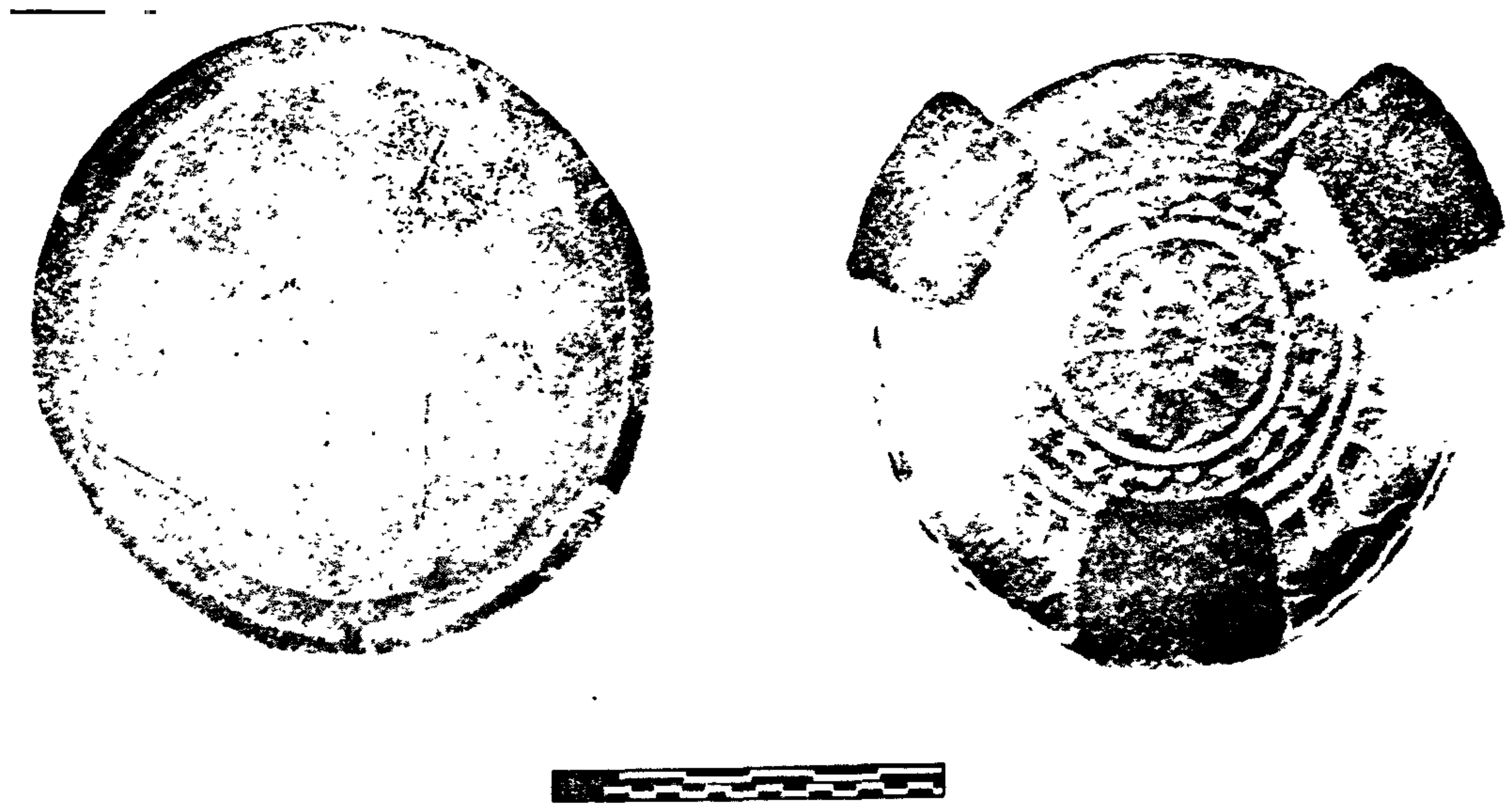
PLATE CCLX

A

B

A, *Perforated anchorstones from dock (Sandstone and miliolite)*: B, *Anchorstone with multiple perforations (limestone). See pp. 565 and 577.*

A



B

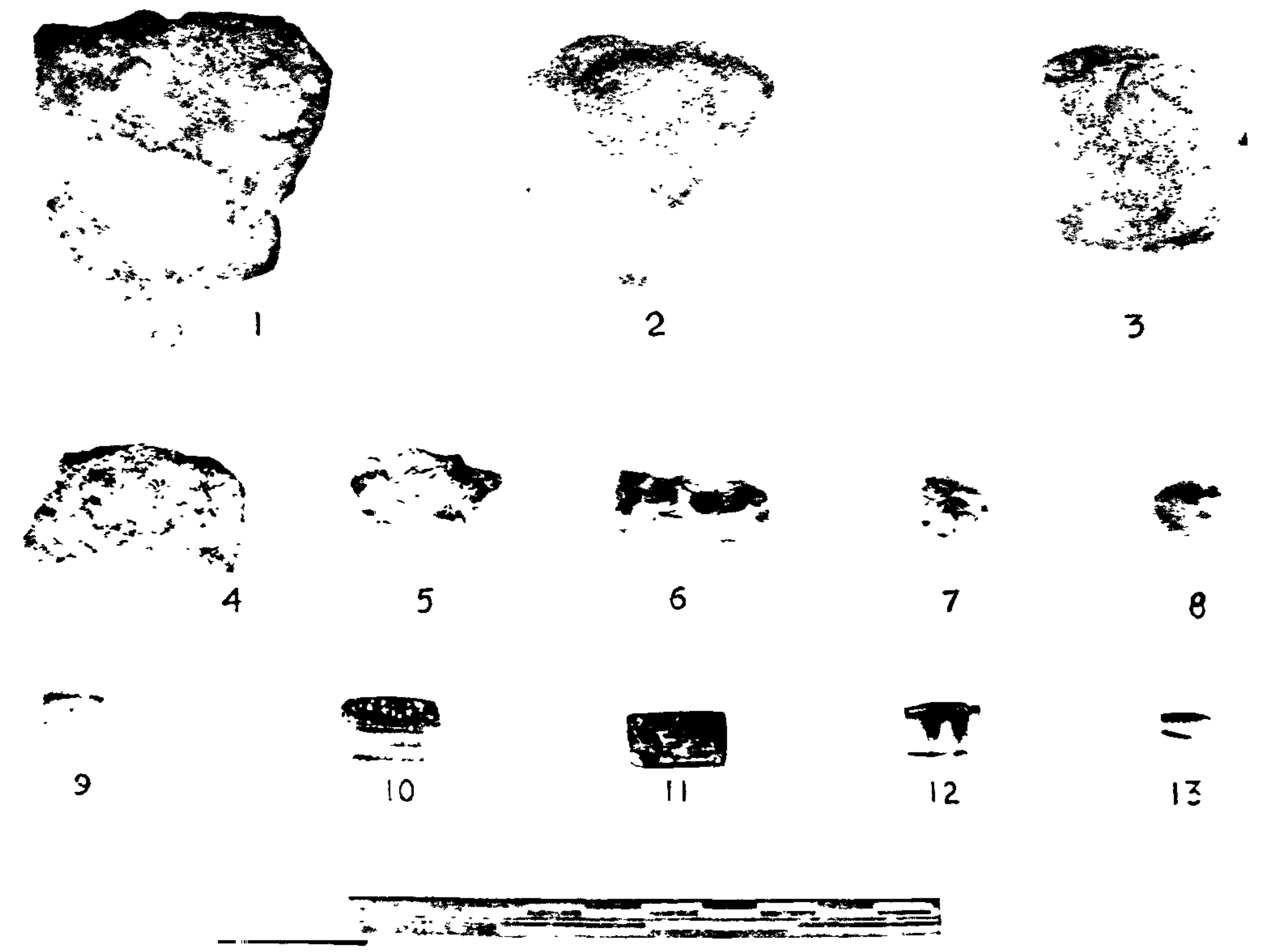
A, Anchorstone in situ on the embankment wall; B, Decorated tripod stand (sandstone).

See pp. 574 and 579

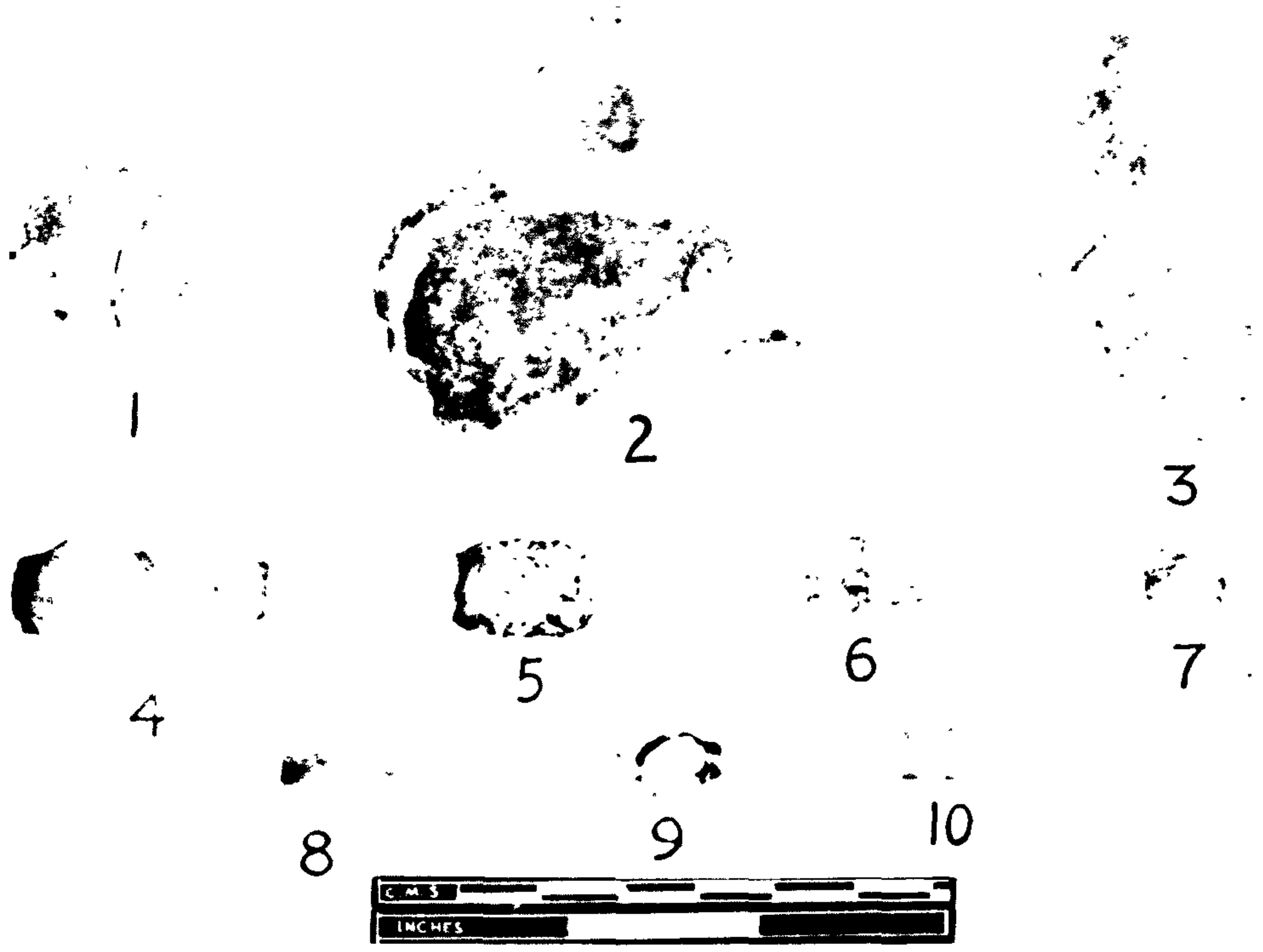
A

B

A. *Burnishers and touchstone (Period A, Agate etc.)*; B. *Arm (Two views) of a statuary (alabaster)*; *Scale 1/3. See pp. 557 and 579*



A



B

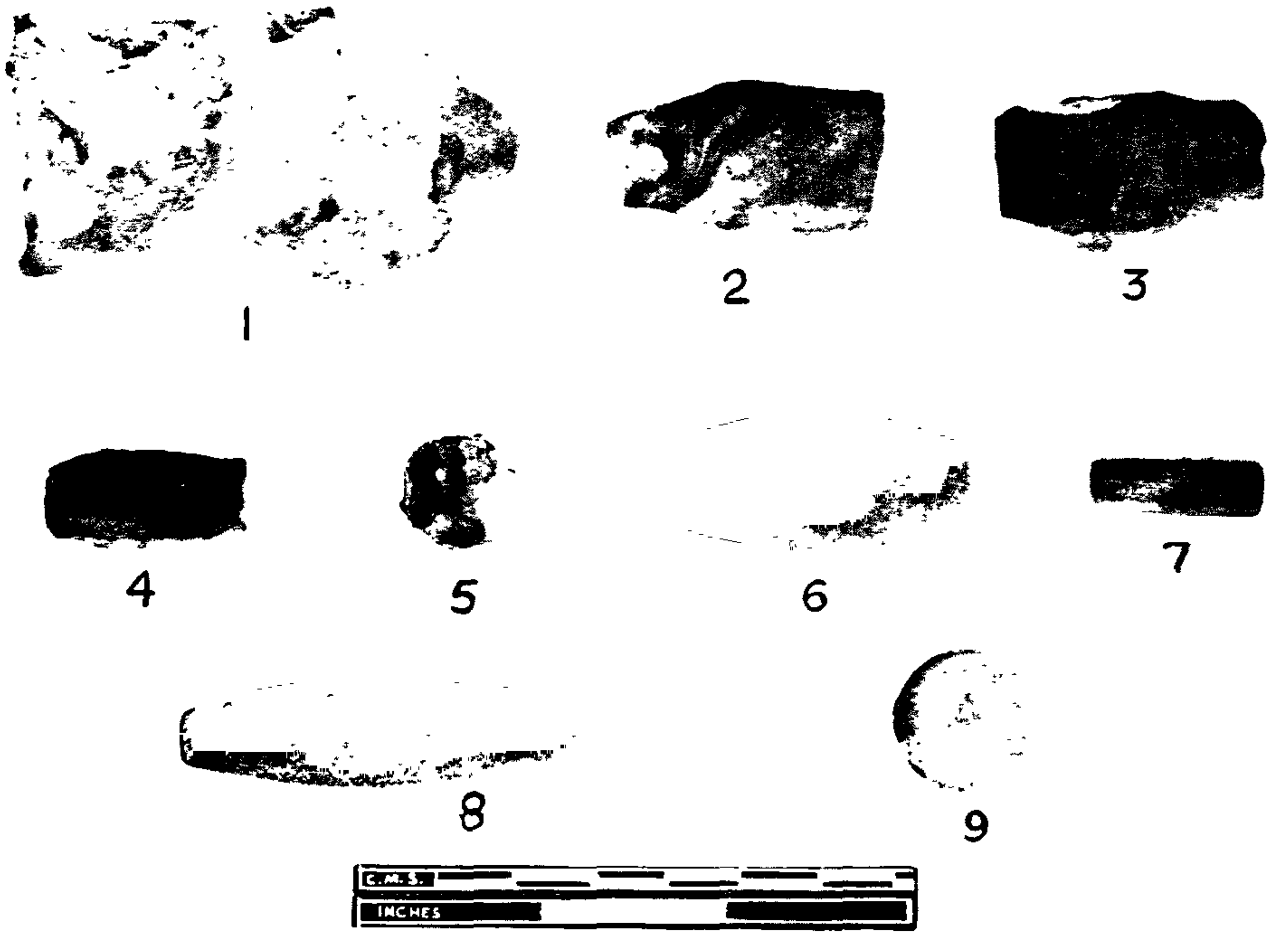
A. 1-3 Pebbles and beads 4-13 agate [illegible] See p. 780 f. B. Agate beads in various stages of manufacture.

PLATE CCLXIV

A

B

A. *A bead-maker heating the stone pebbles in pot-furnaces, Cambay*: B. *removing the cortex of the pebble by slowly giving blows with a hammer of buffalo horn.* *See p. 581*

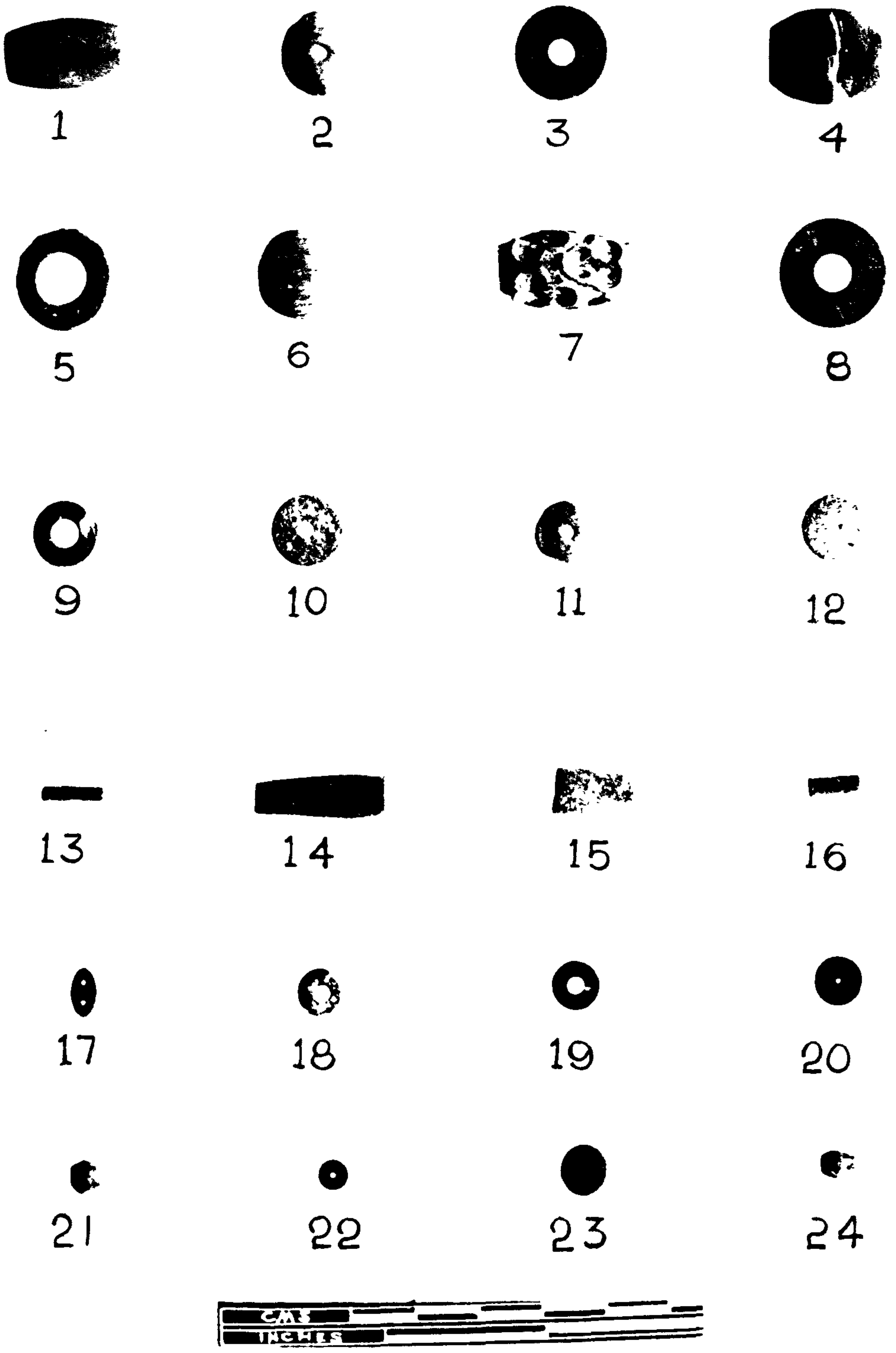


A

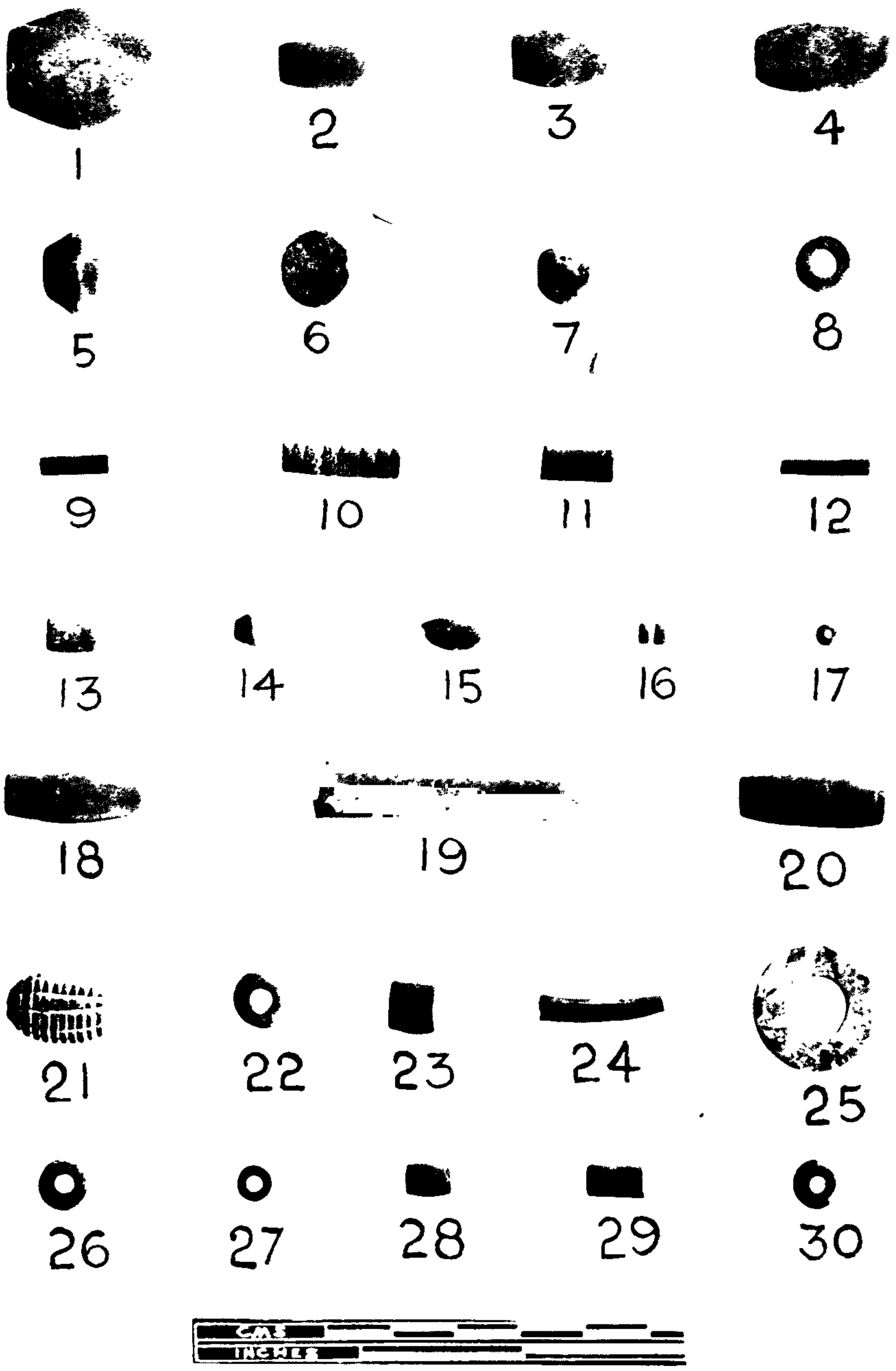
B

A, *Stone beads from Cambay in various stages of manufacture*; B, *Lapidaries grinding and polishing the beads at Cambay.* *See p. 581*

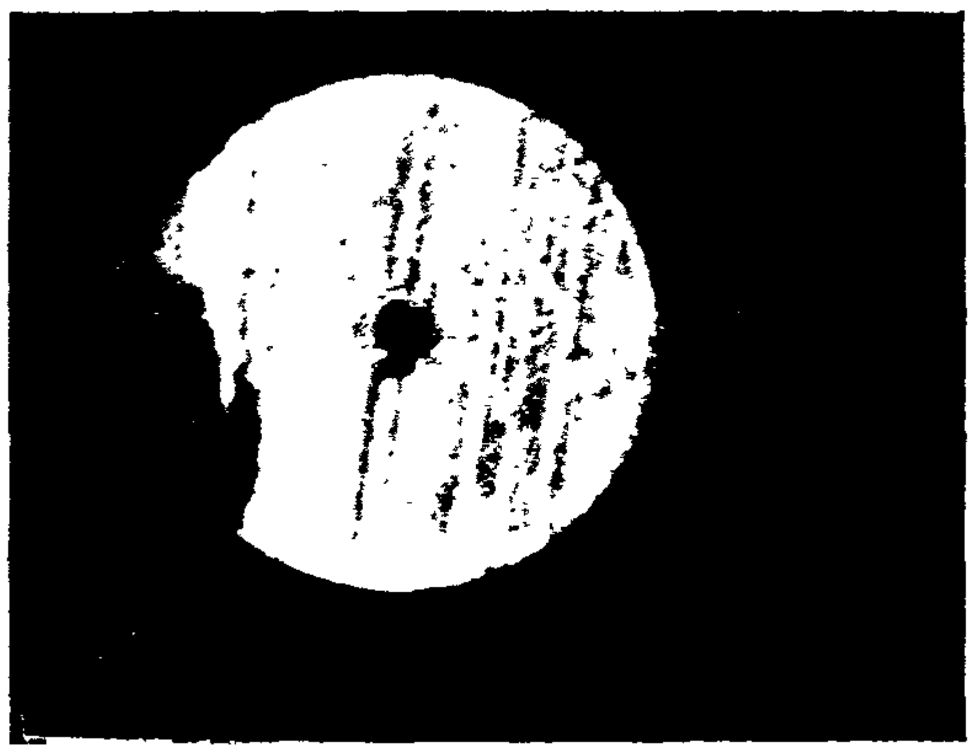
Terracotta beads. See p. 593ff



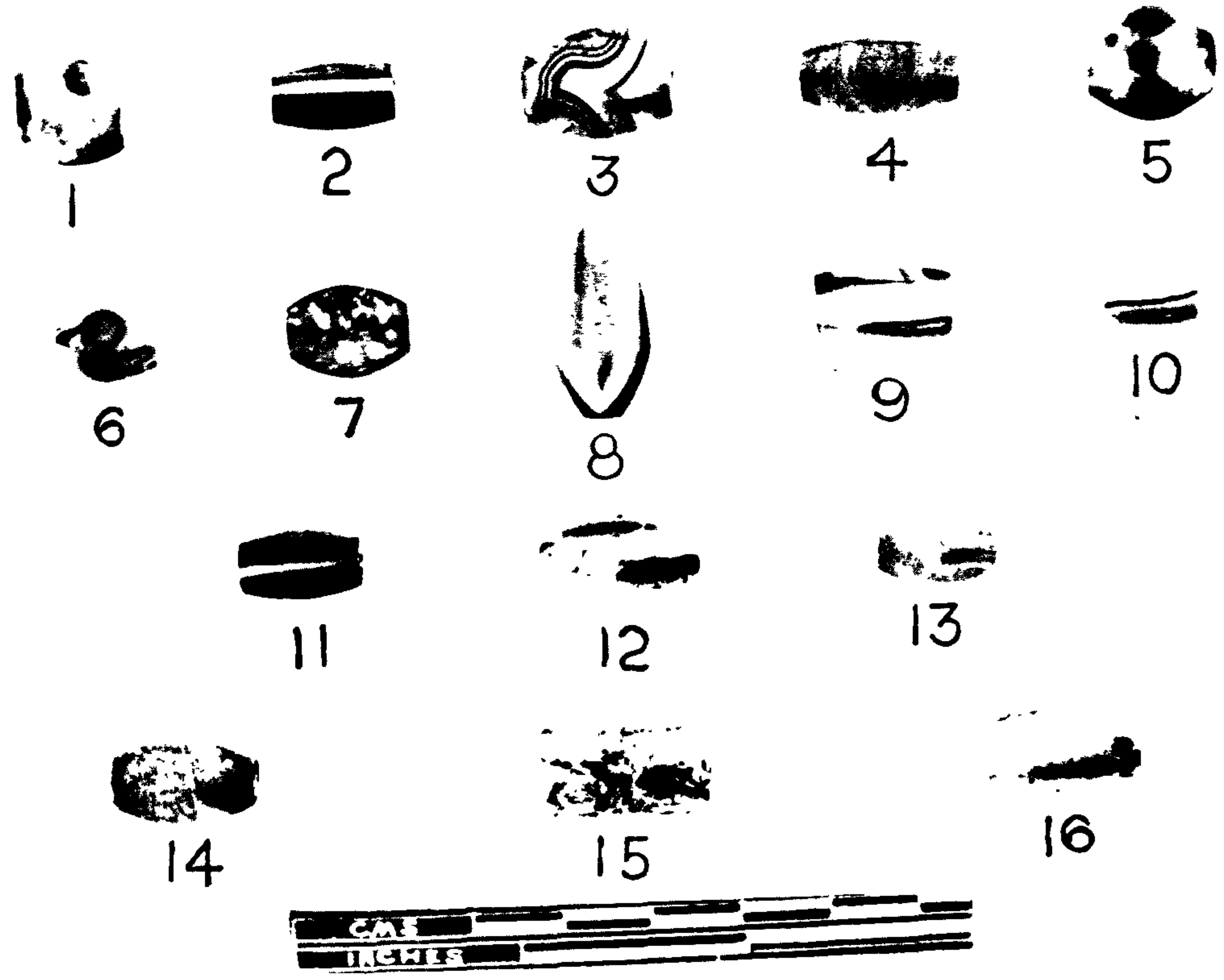
Steatite beads. Nos. [illegible] and [illegible]



Beads, 1-17 faience; 18-30 shell. *See p. 597*

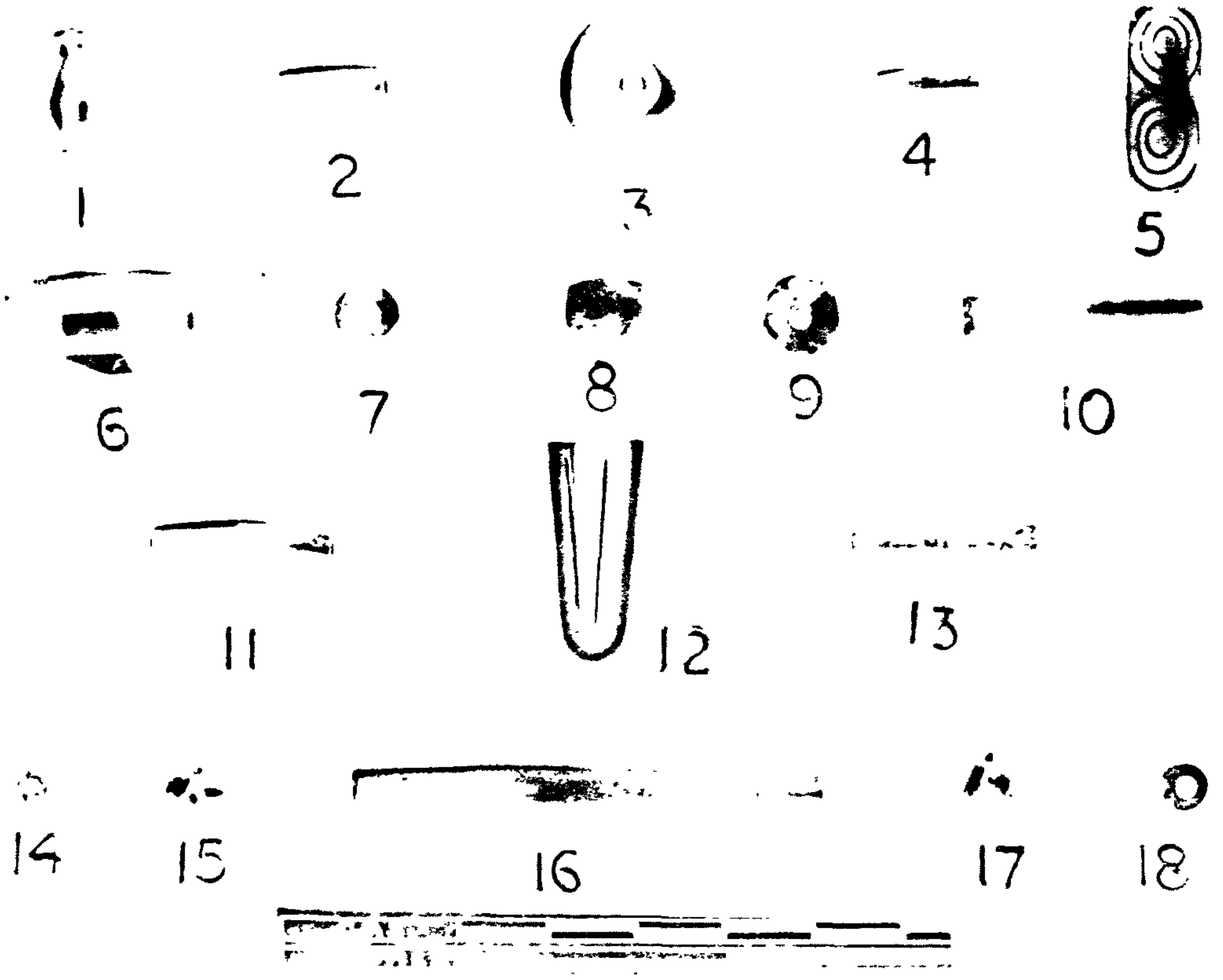


A

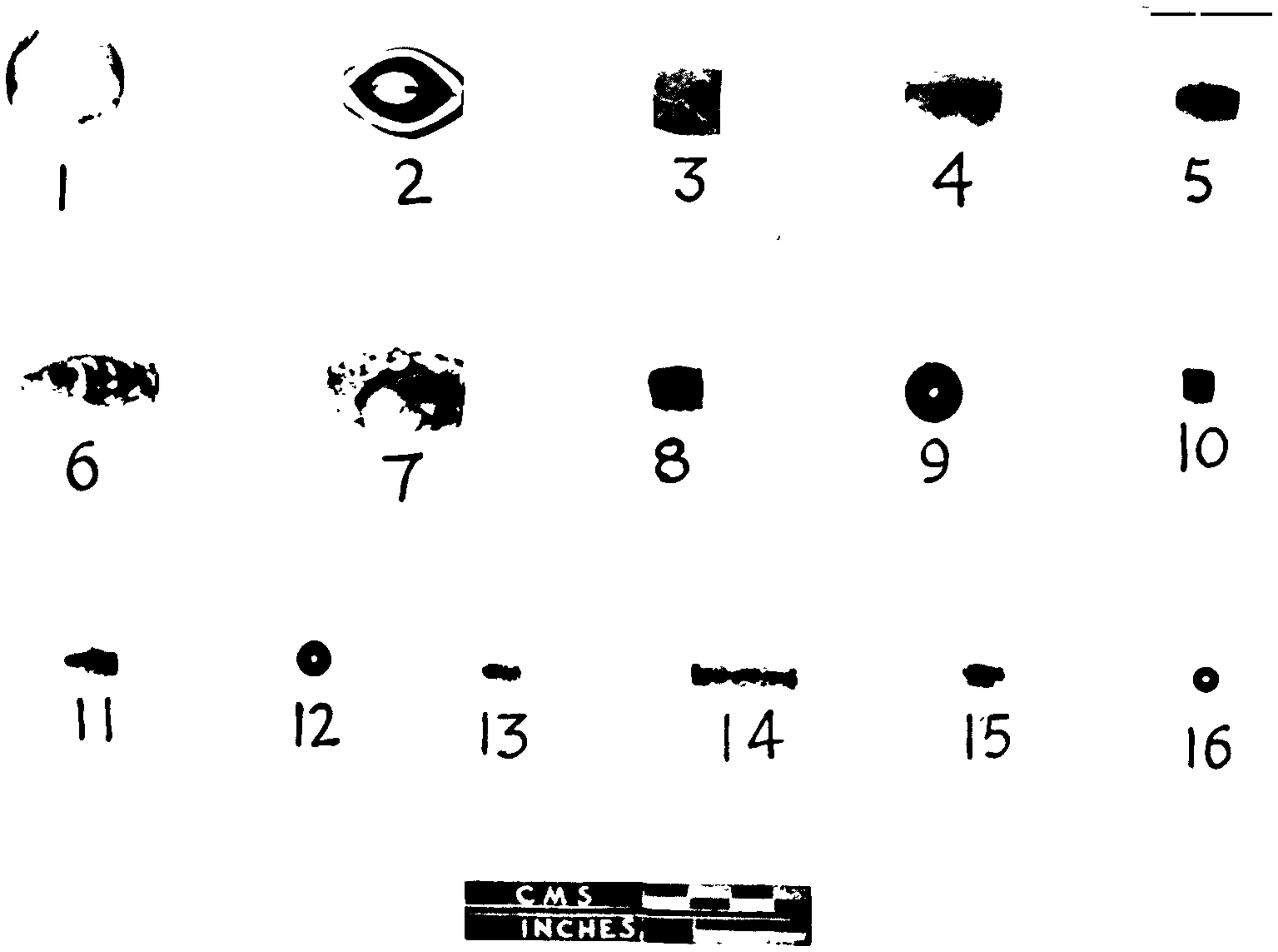


B

A. *Wire-marks on a steatite disc-bead from Lothal. Scale 2/1.* B. *Agate beads. See pp. 597 and 600*

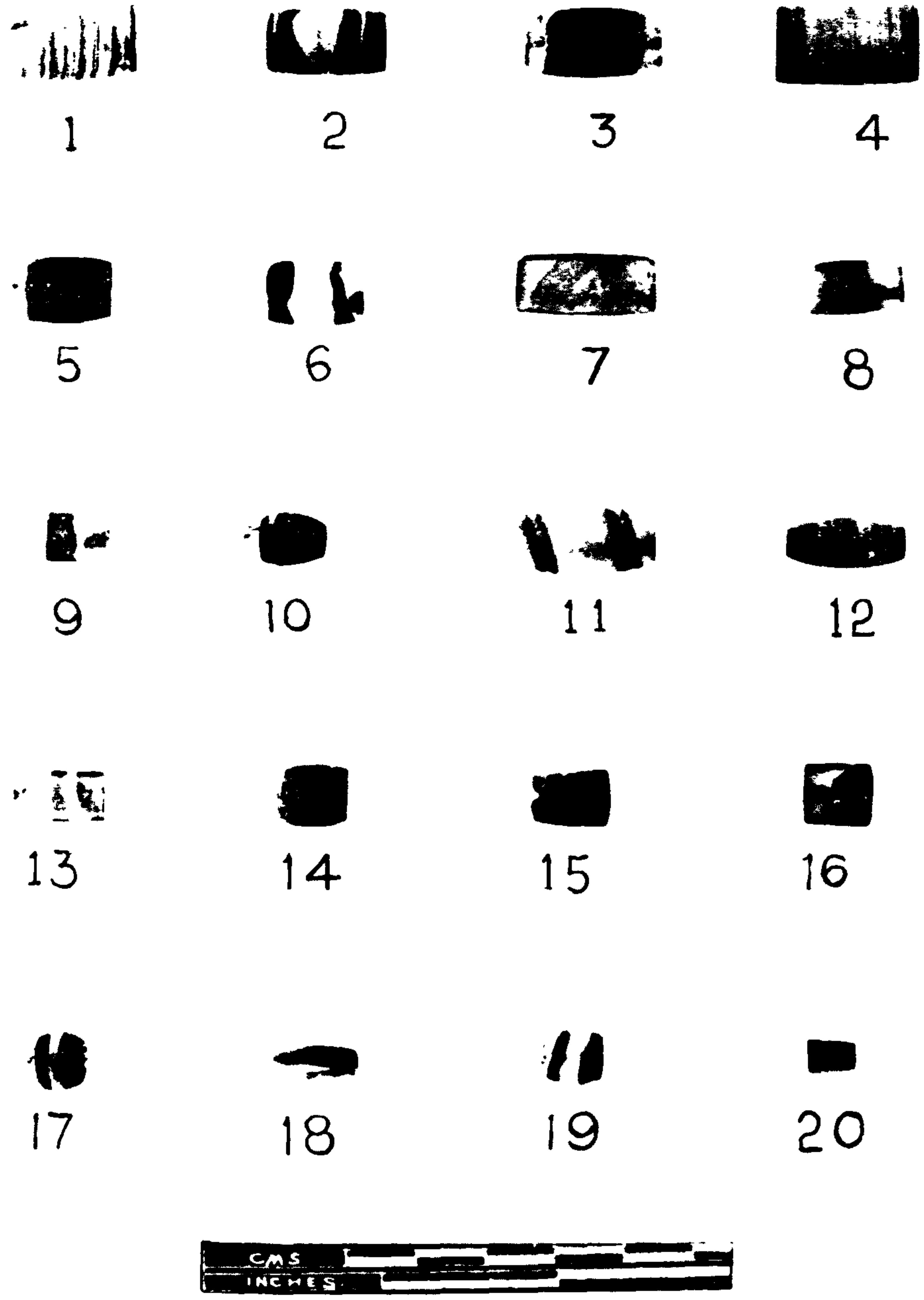


A

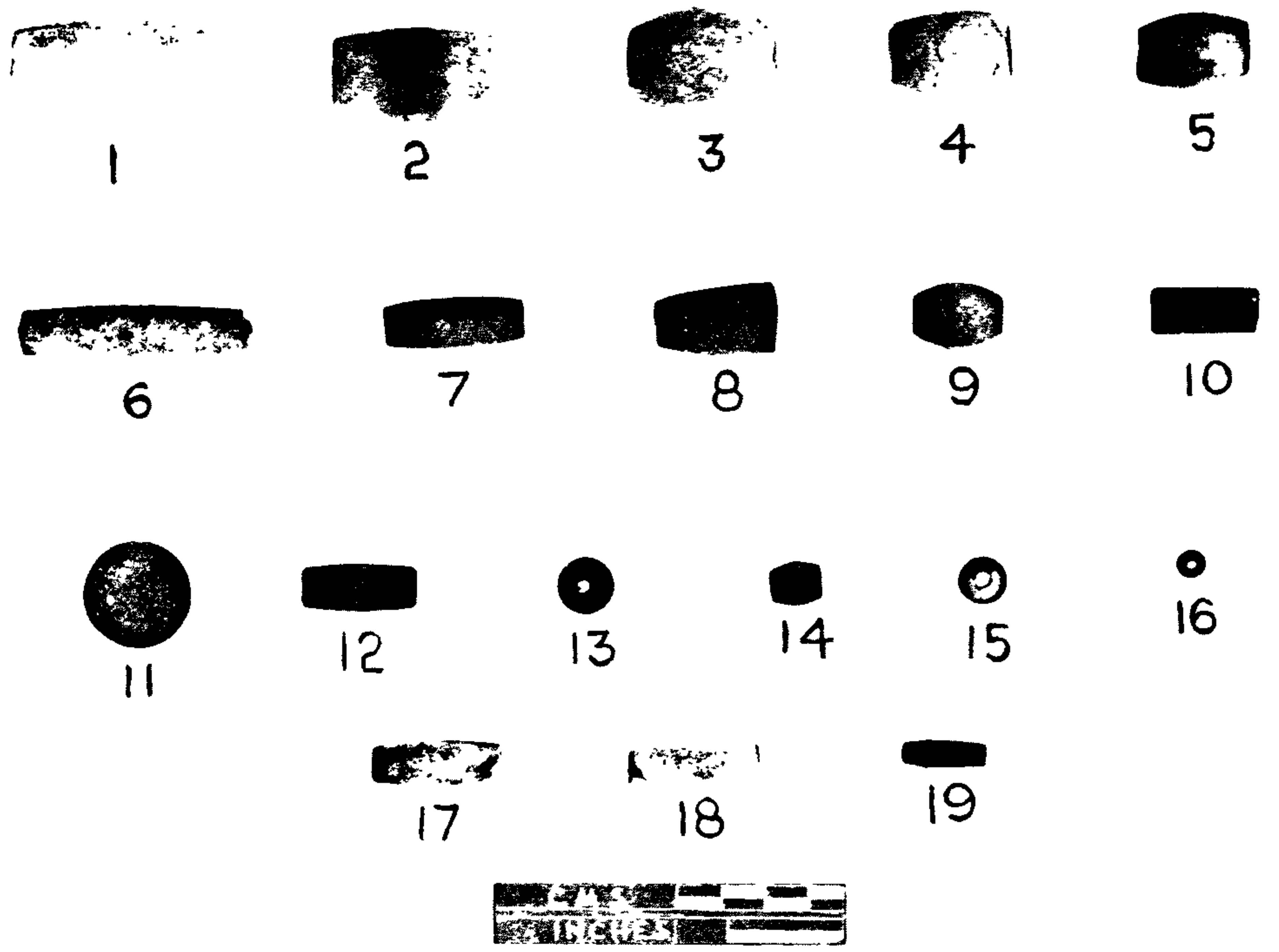


B

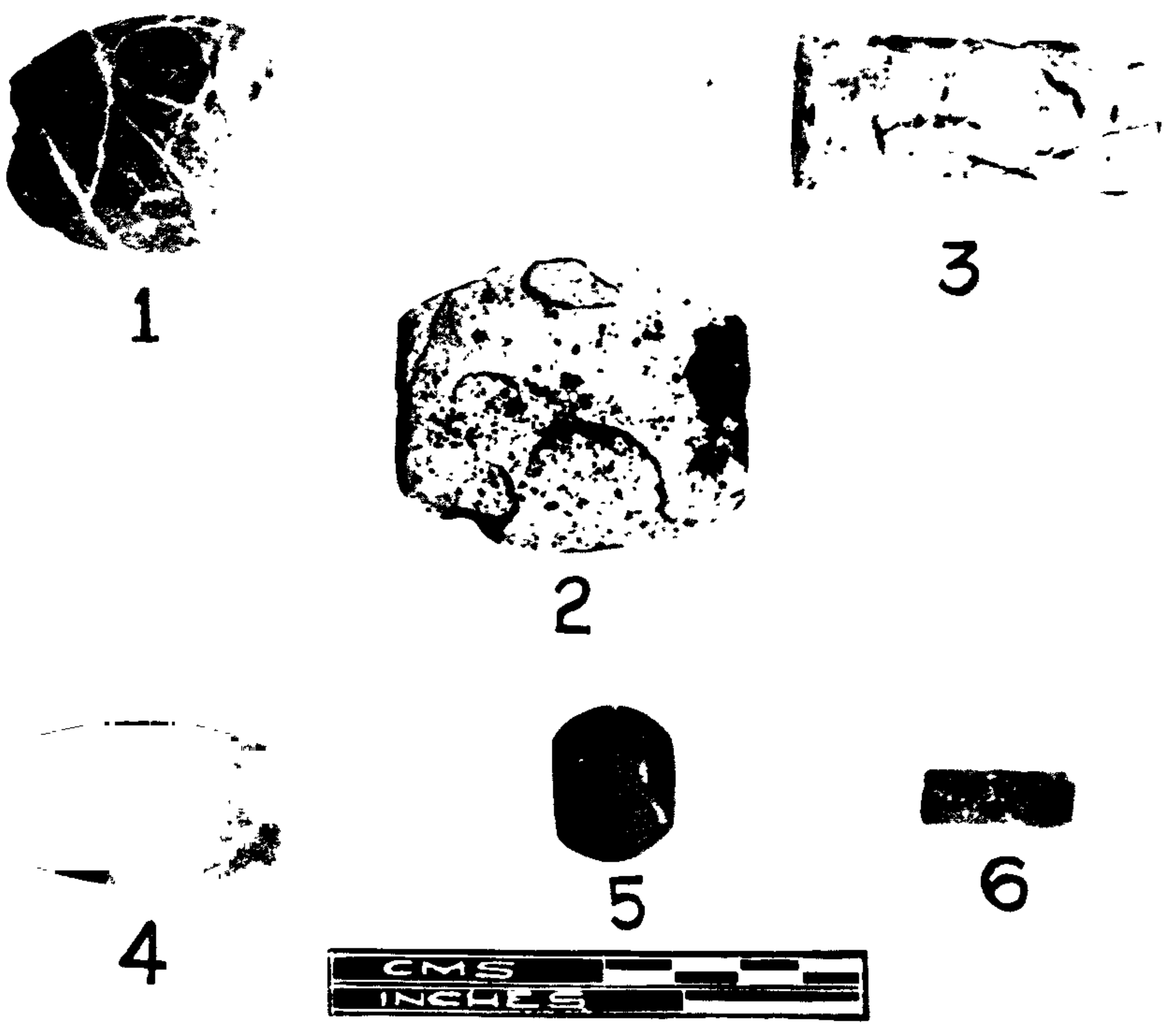
A, *Carnelian beads*; B, *Jasper beads. See pp. 600ff*



Onyx beads. See p. 603 ff.

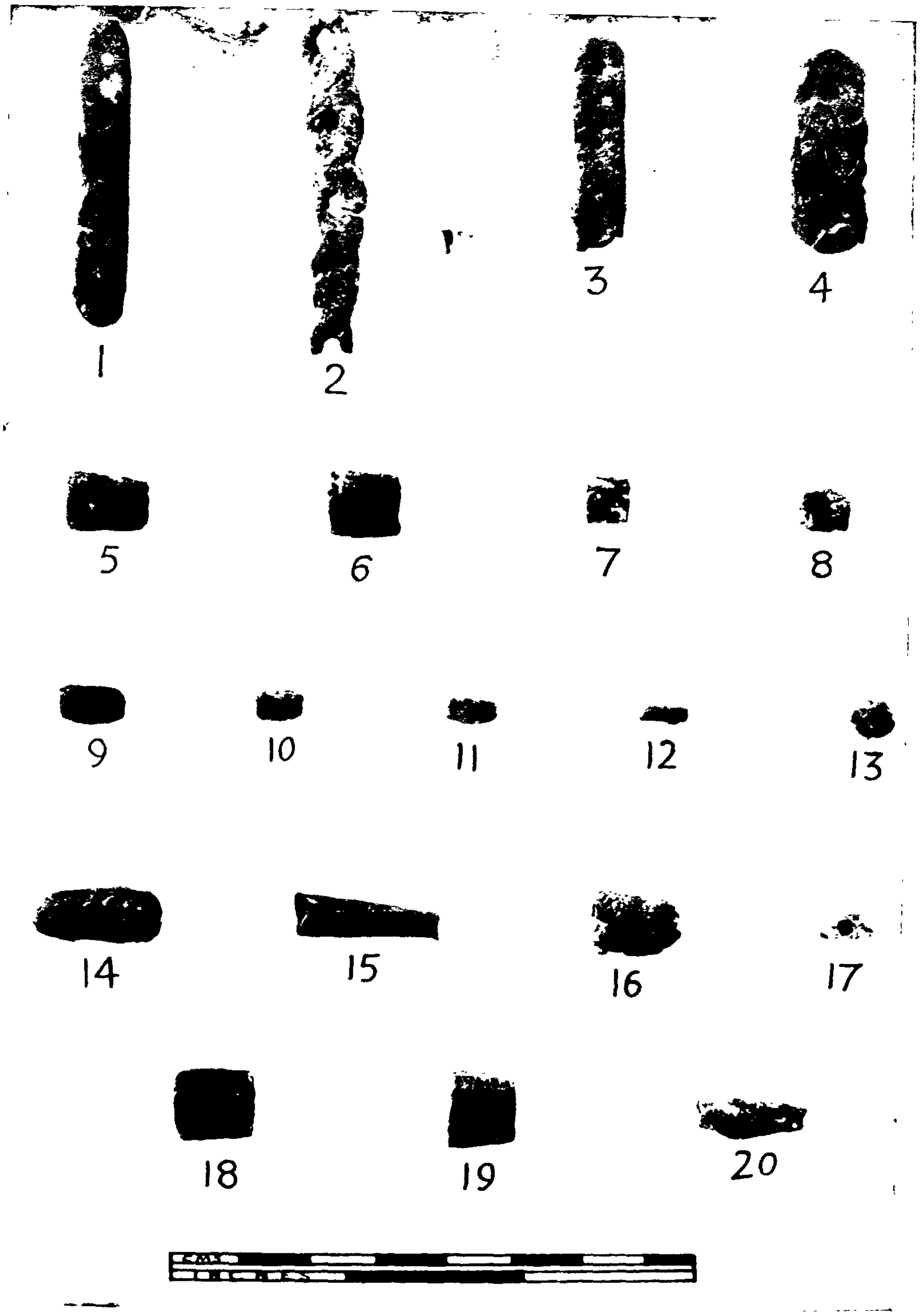


A



B

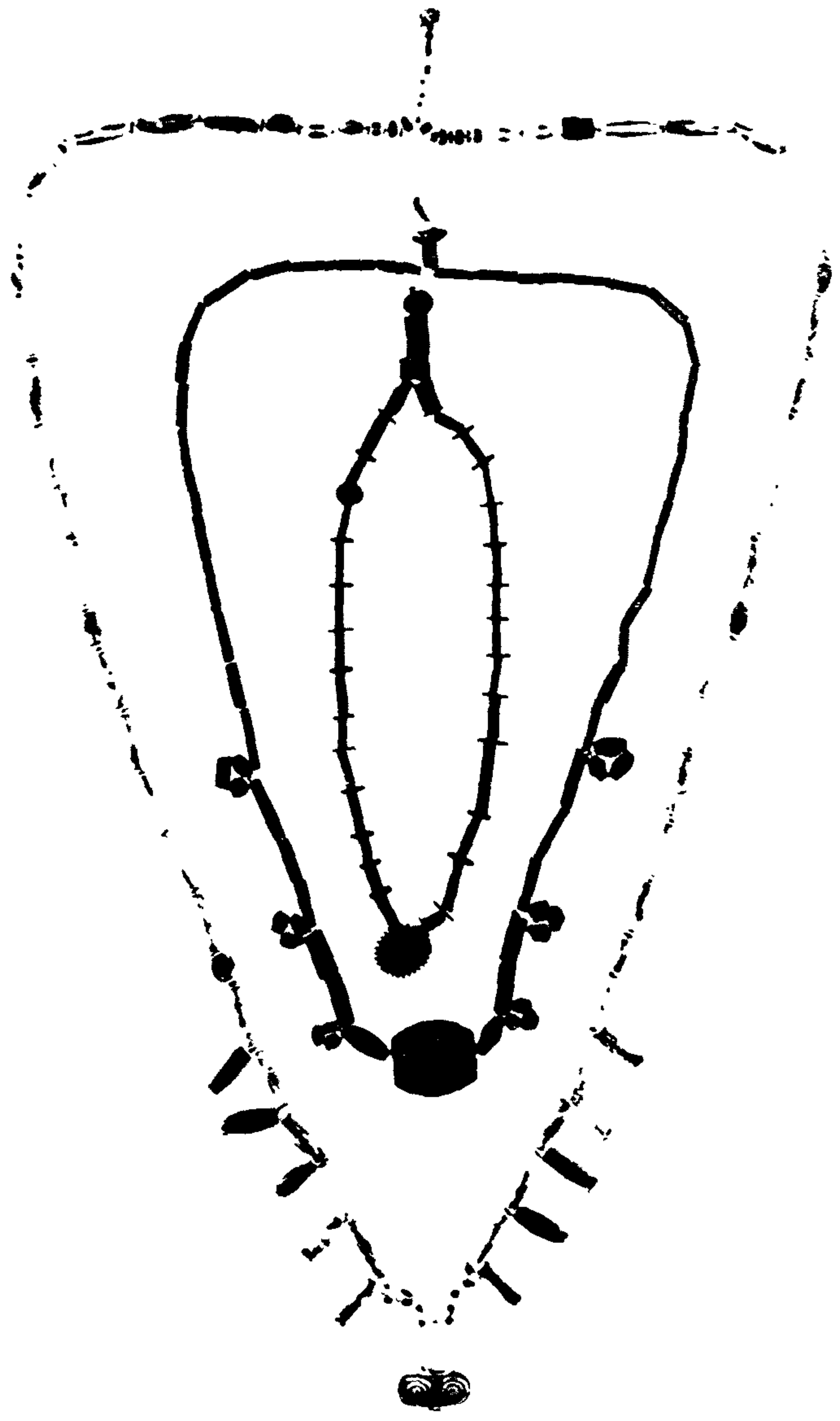
A, *Assorted stone beads*: B, *Miscellaneous beads.* *See p. 605ff*



Copper beads. See p. 605ff

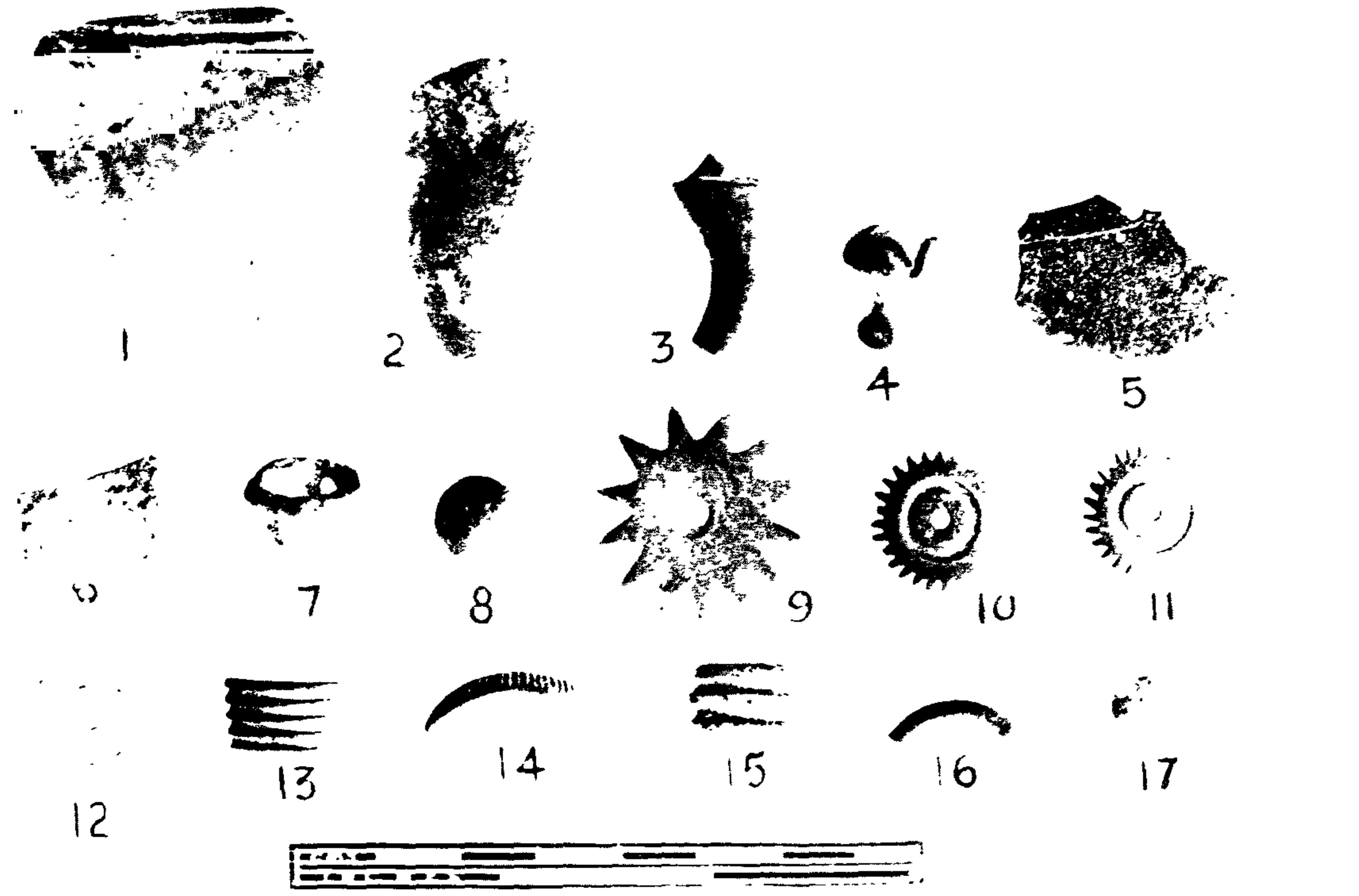
PLATE CCLXXIV

Carnelian and agate beads of variegated colours. See pp. 585 and 608ff

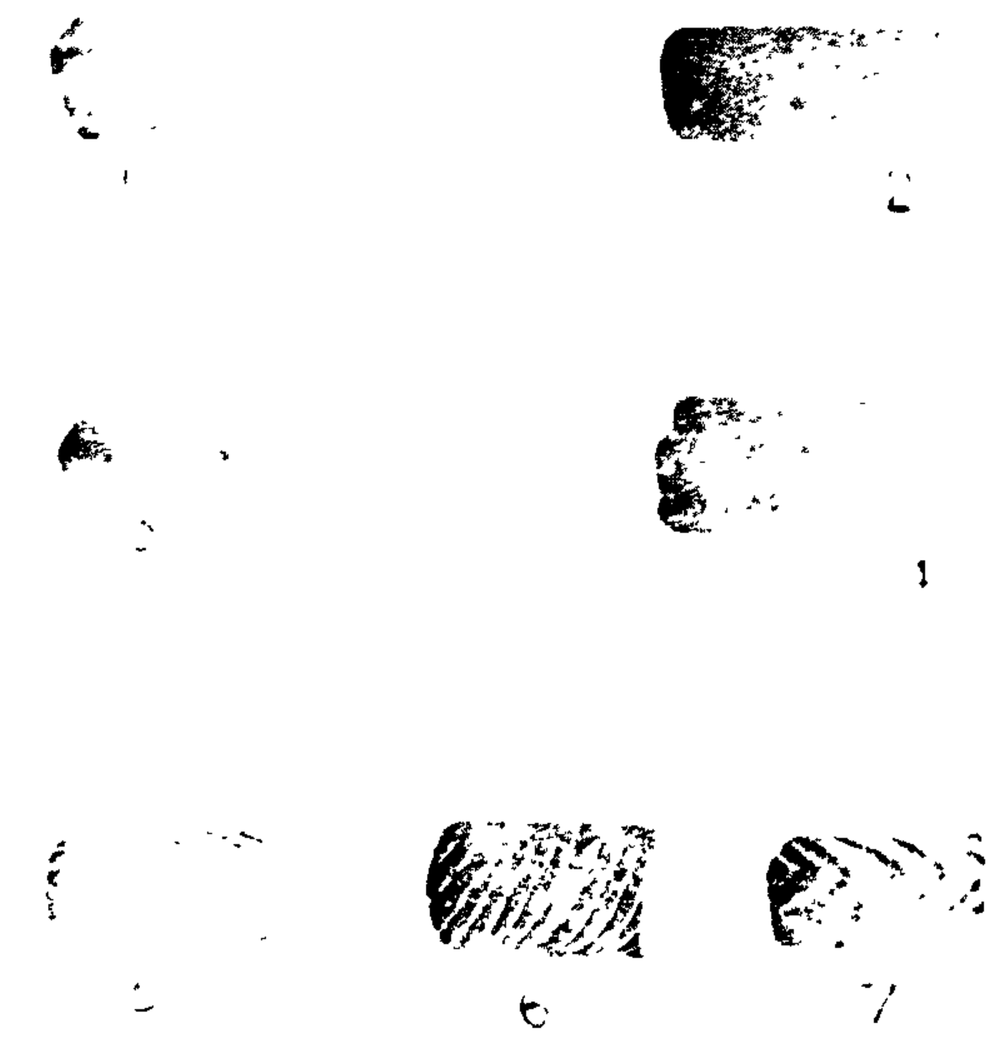


Beads of faience, steatite and semi-precious stones and etched carnelian pendant. *See pp 585 and 608ff*

PLATE CCLXXVI

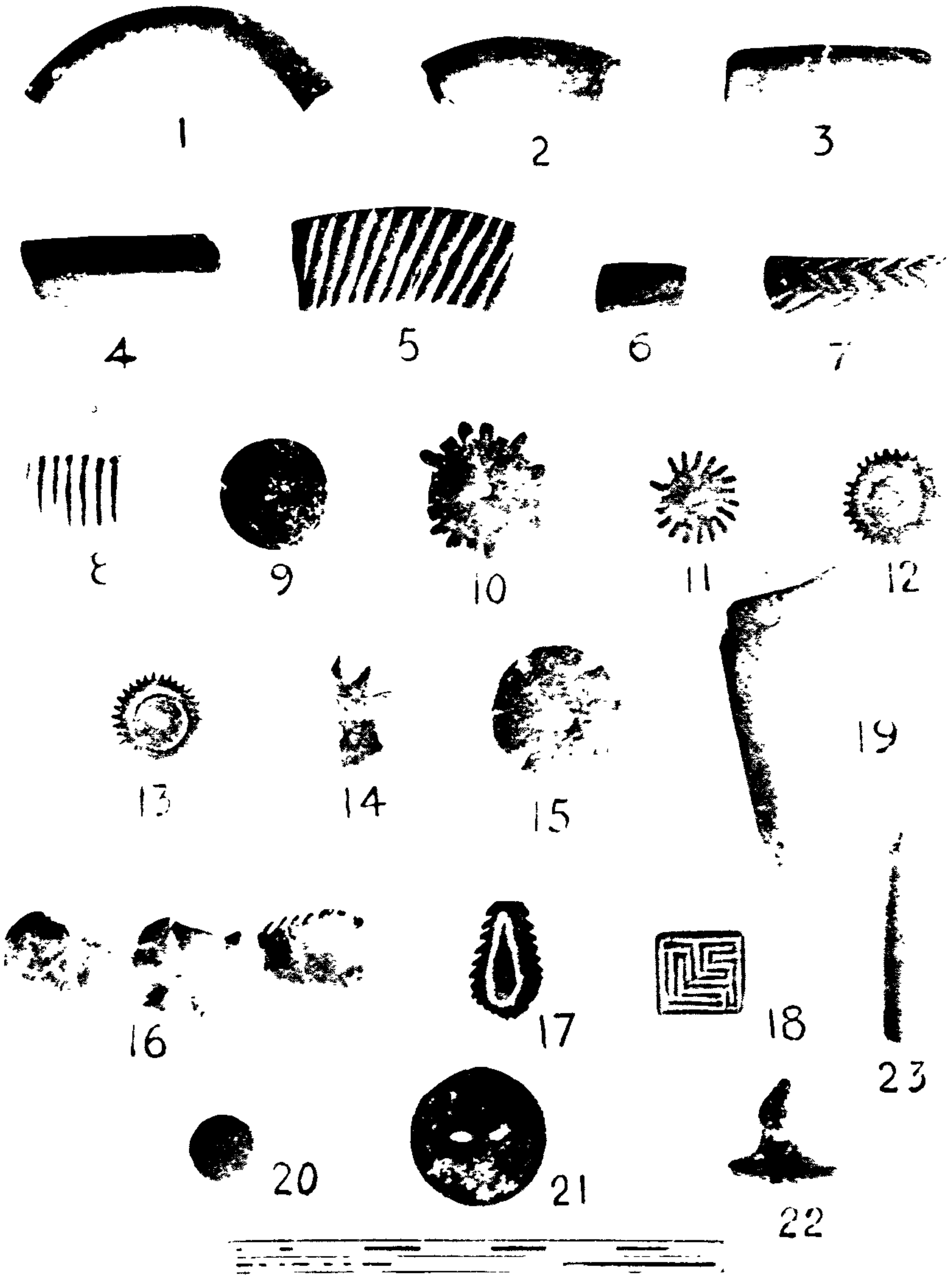


A



B

A, *Faience objects: 1-2 vessels; 3 handle of a vessel; 4-5, 7, 9-12 ear-ornaments; 6 and 8 pendants; 13-16 rings; 17 button;* B, *Faience bangles. See pp 609, 610 and 612*



A

B

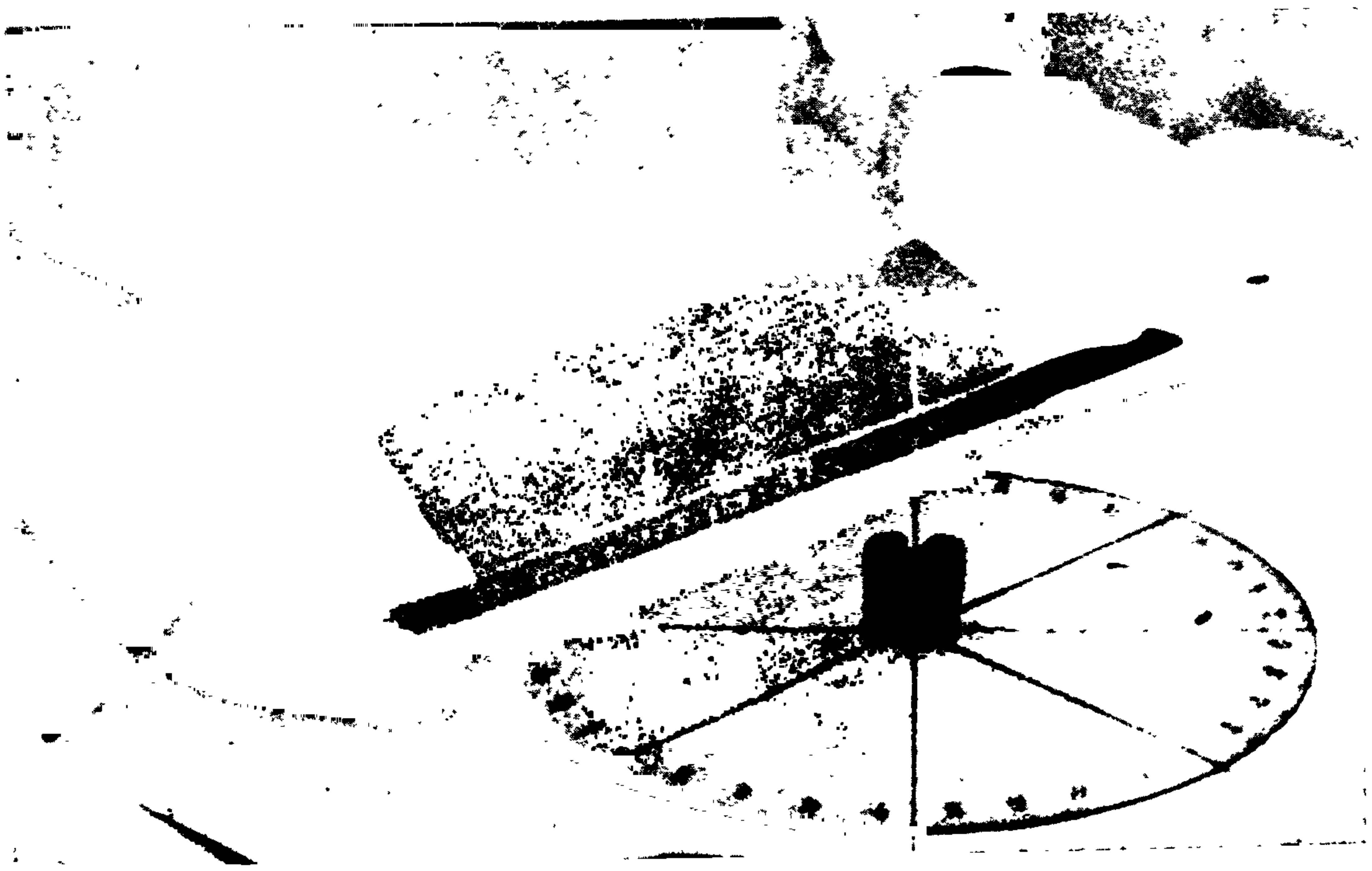
A, Steatite objects: 1-7 bangles; 8 ring, 9 pendant, 10-14 ear-ornaments (cogwheels); 15 ear-stud; 16-17 other types of ear-ornaments; 18 seal 19, conical ornament; 20-21 buttons; 22 lid; 23 pencil. B, *Heart-shaped steatite ornament. See pp. 610, 612, 613 and 614*

A

B

A, *Rejected Columella and flakes of chank-shells*; B, *Ladles and vessels of Chank shell; 1-5 ladles; 6-9 parts of vessels. See pp. 614, 615 and 617*

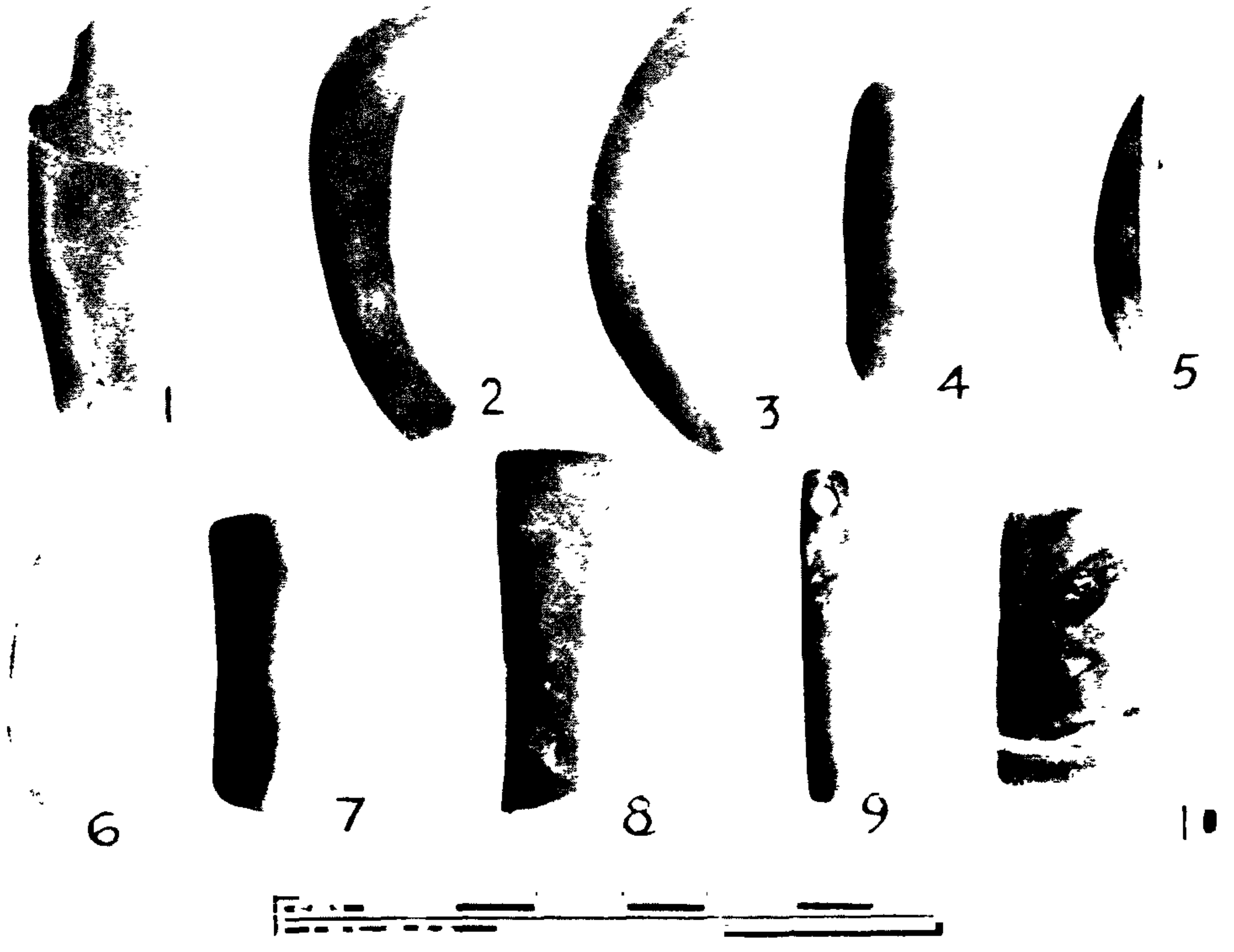
A



B

A, Compass made of shell for measuring angles, note the grooves in the lower and upper margins; B, Above object being used for measuring angles, lines on the compass pass through the grooves. *See pp. 616 and 619*

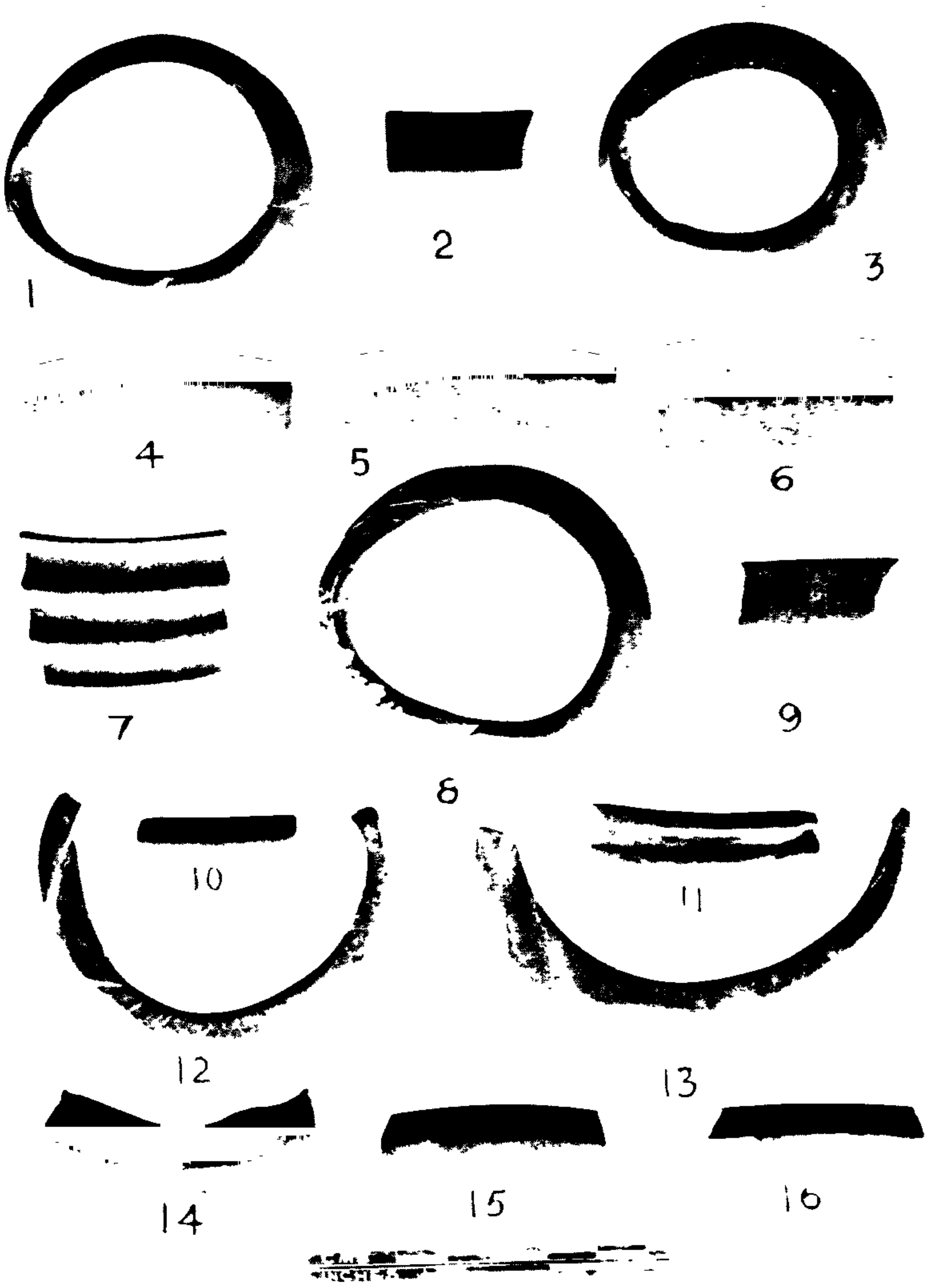
PLATE CCLXXX



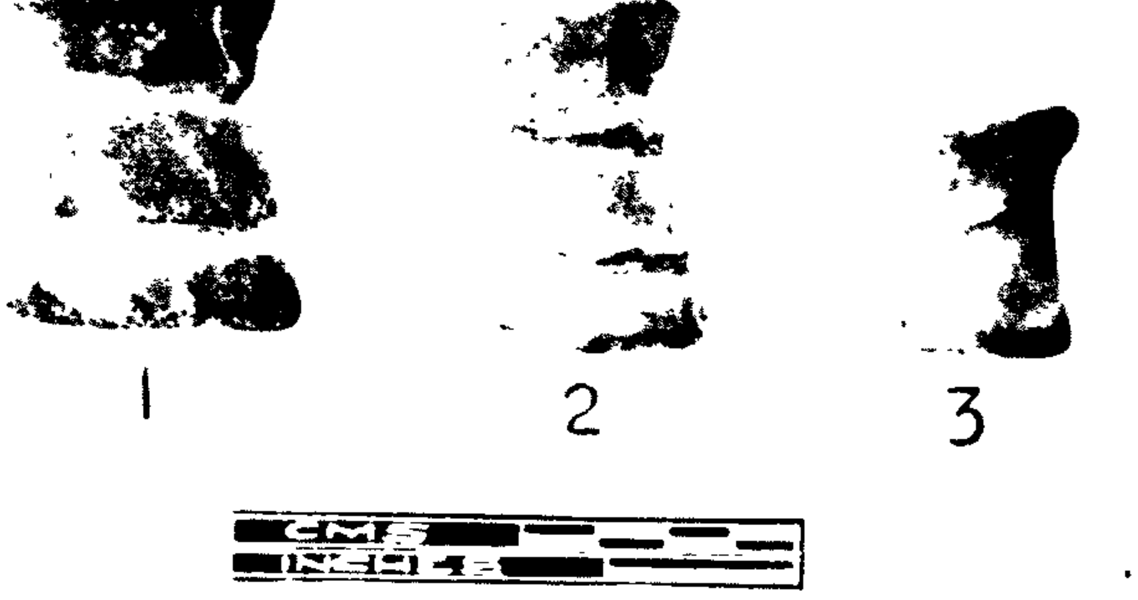
A

B

A, Tools made of chank shell: 1 knife, 2-3 engravers: 4 scraper; 5-6 points; 7 burnisher: 8 and 10 handles: 9 needle : B. 1 Plectrum and 2 'bridge' made of shell (used in stringed musical instruments). See pp 616 and 619

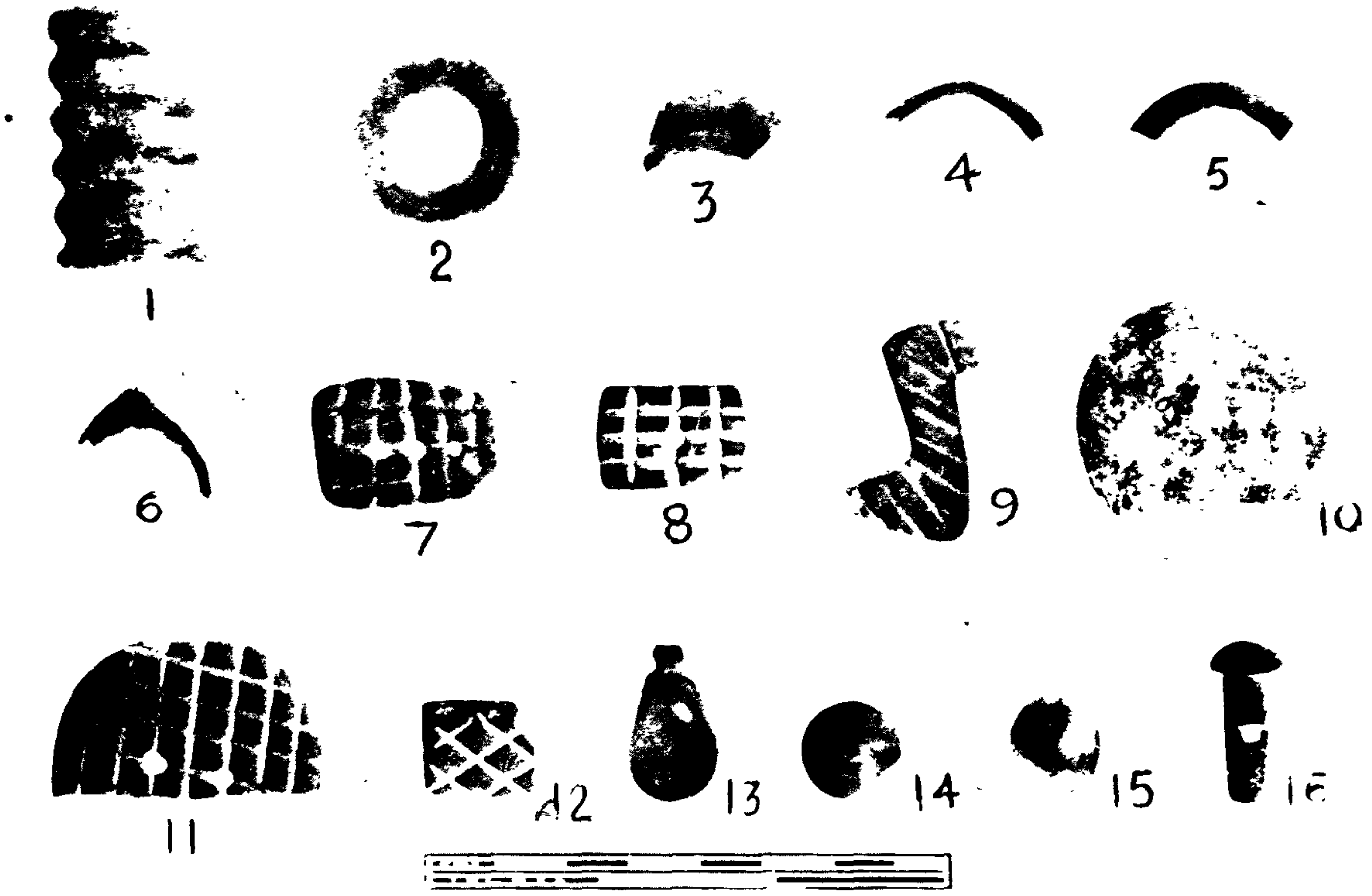


A

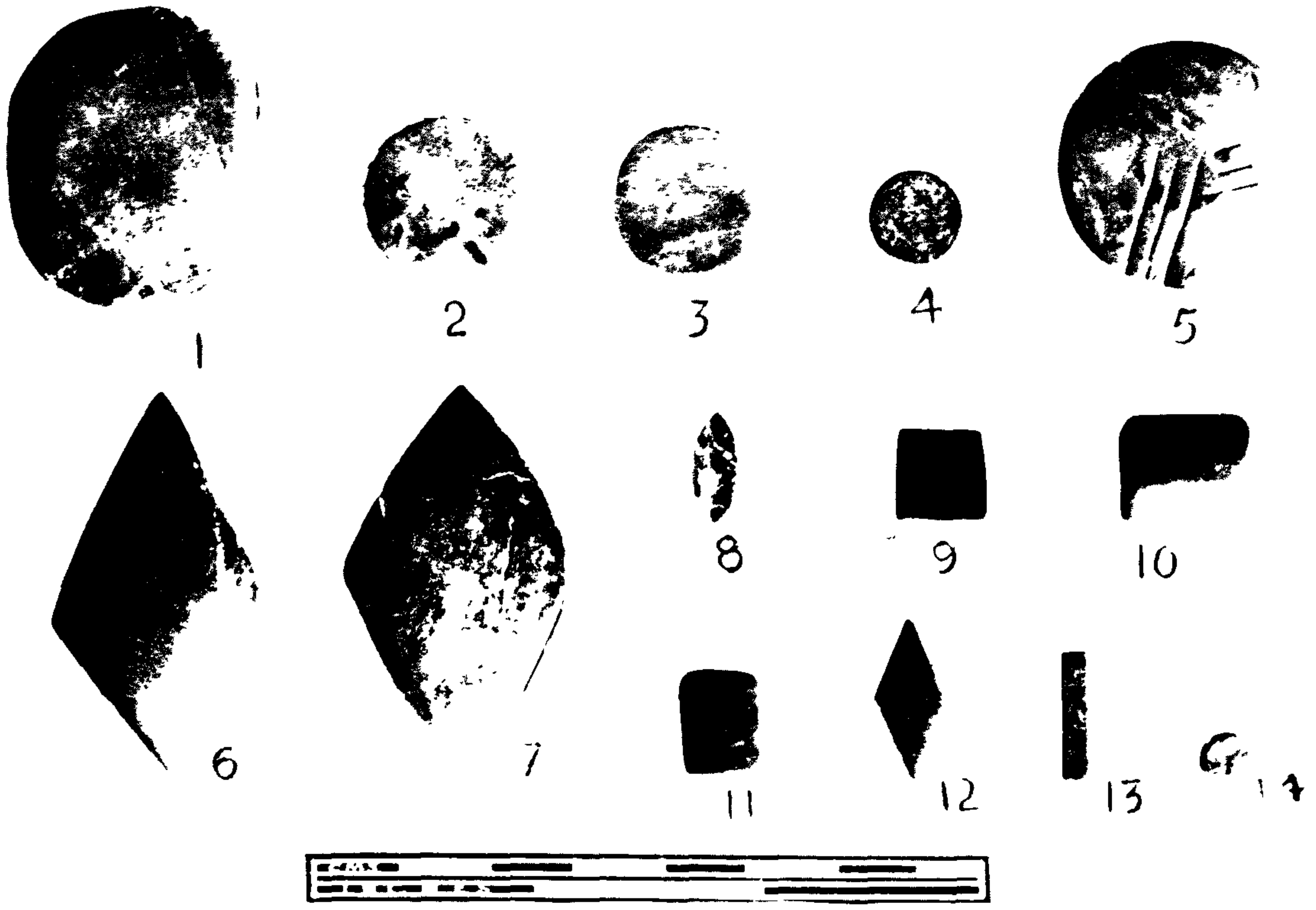


B

A. *Shell bangles* ; B. *Gamesmen (shell)*. *See pp.* 616, 617, 619 *and* 620



A



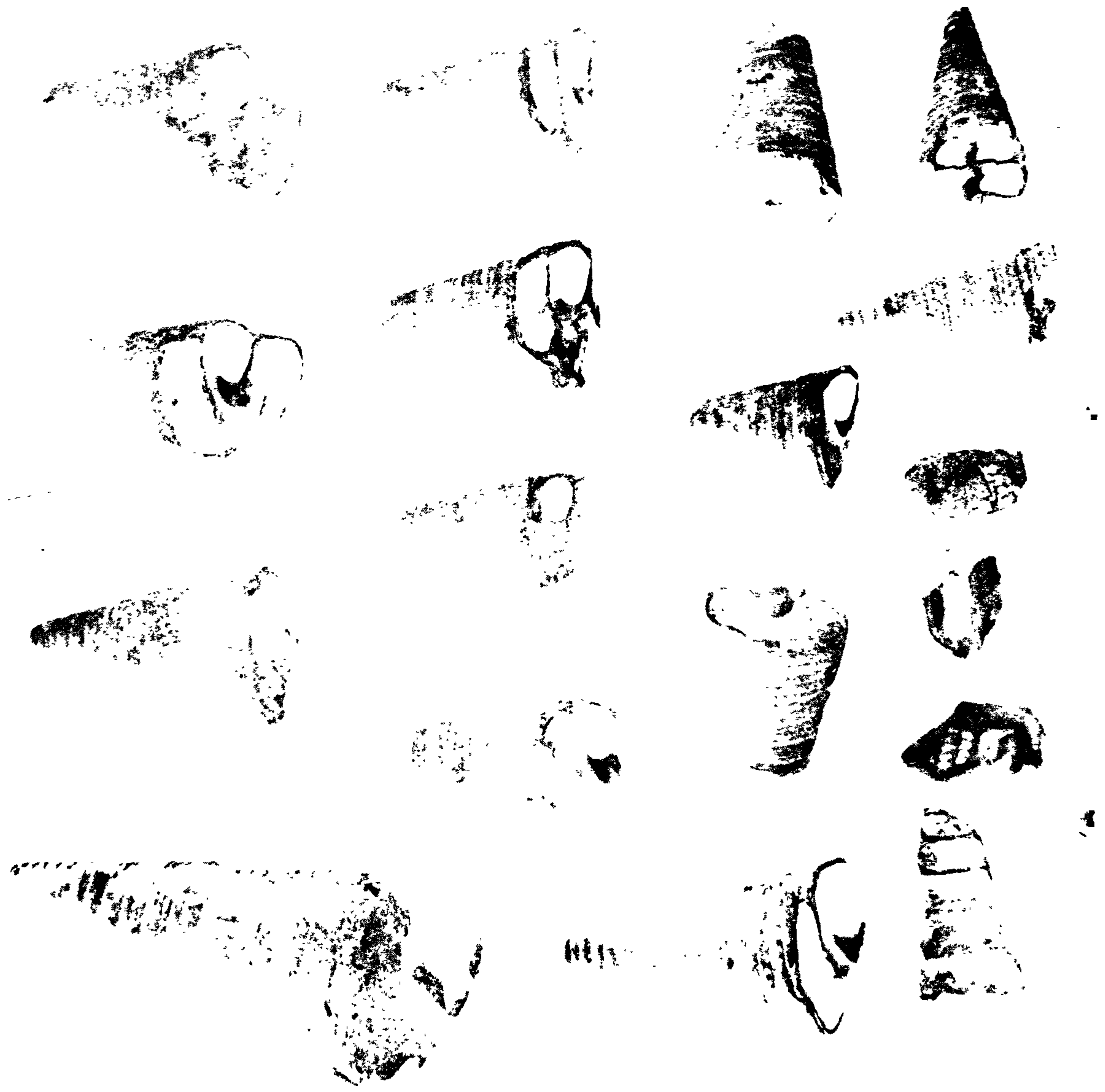
B

A. *Shell objects: 1-6 rings; 7-14 inlays; 14-15 buttons; 16 ear-stud;*
B. *Inlay pieces (shell). See pp. 616, 617 and 620*

Conus figulinus (Linn.). *See p. 621*

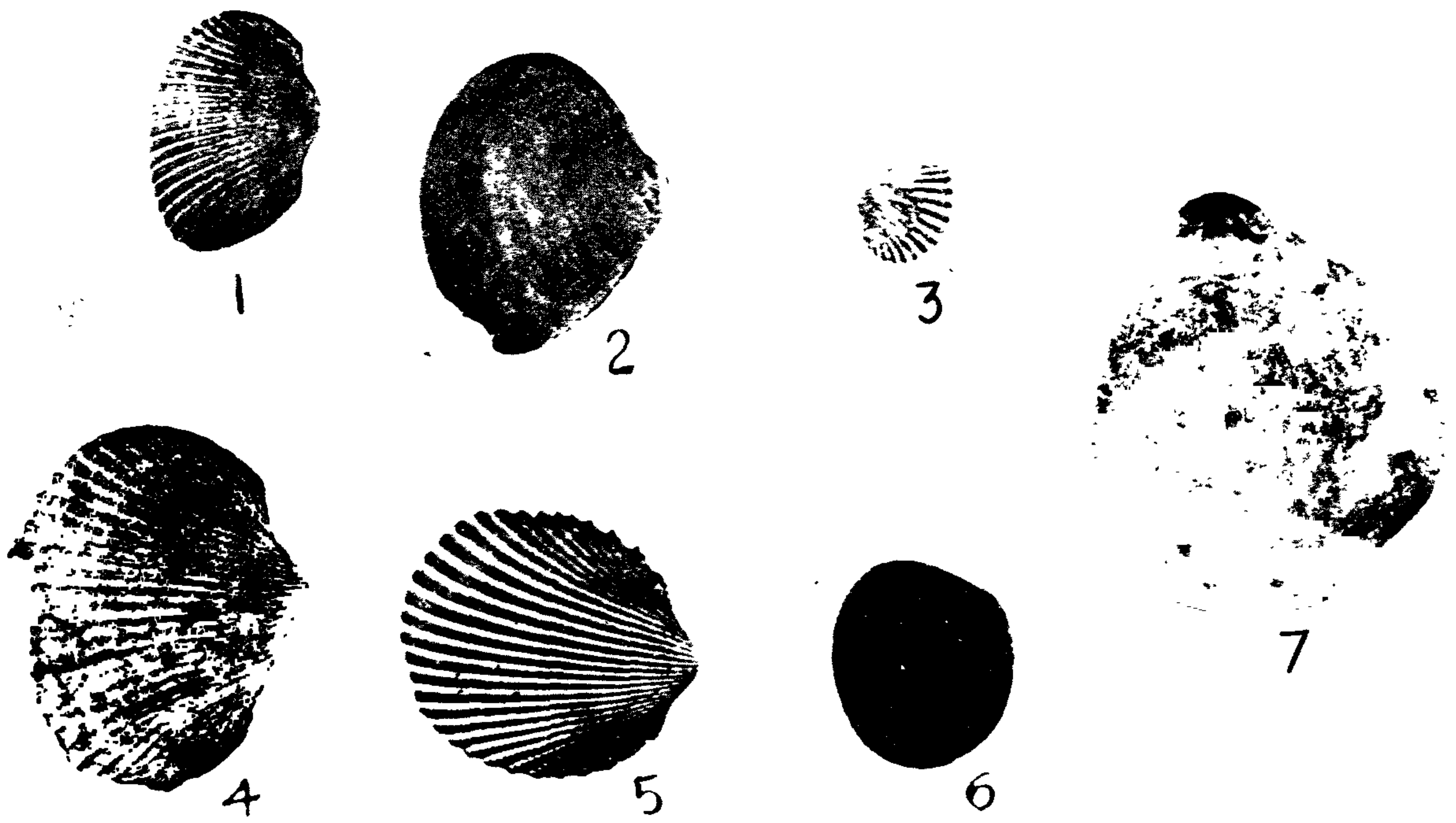
PLATE CCLXXXIV

Terebralia palustris (*Linn.*). See p. 621

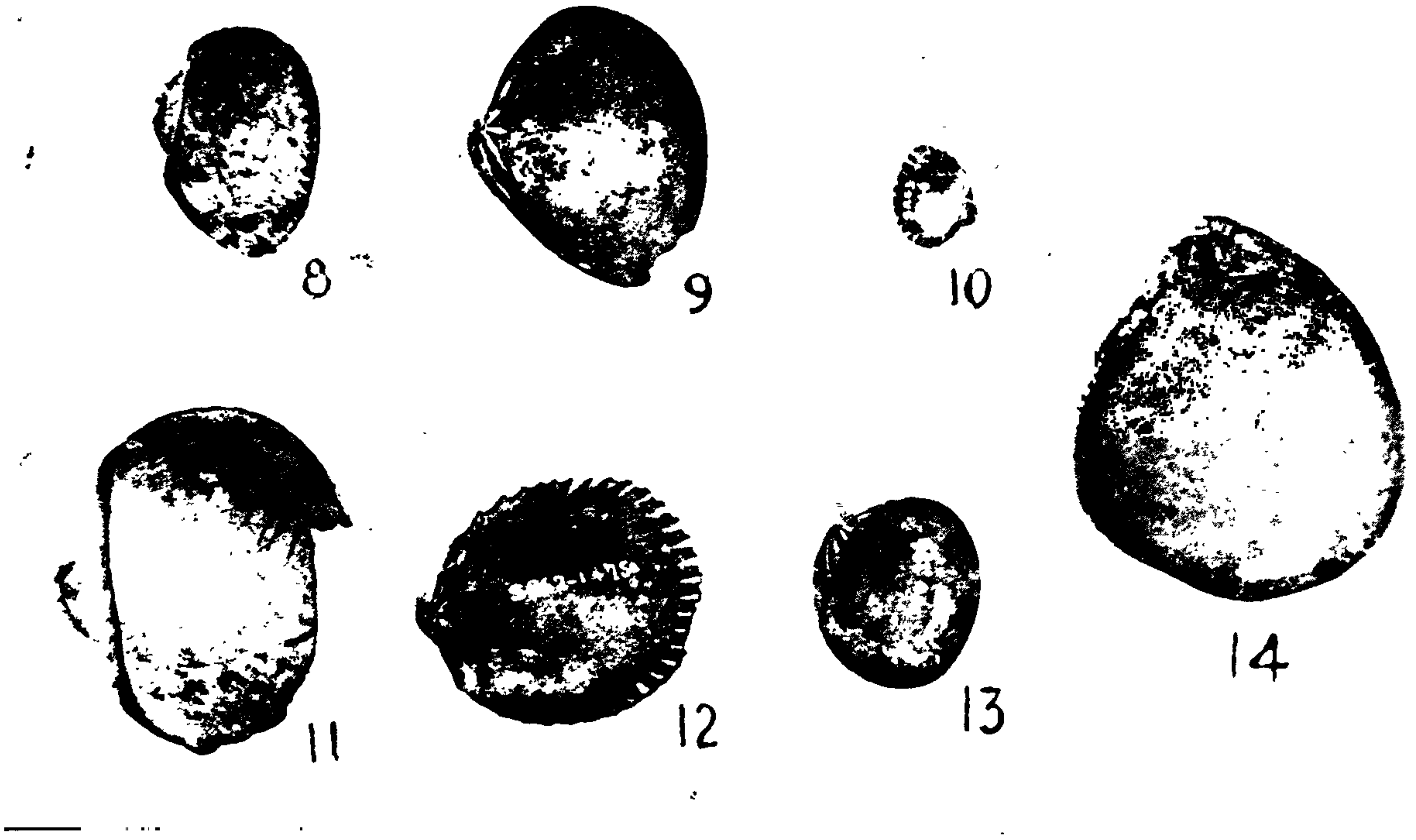


Terebralia palustris (*Linn.*). *See p.* 621

PLATE CCLXXXVI



A



B

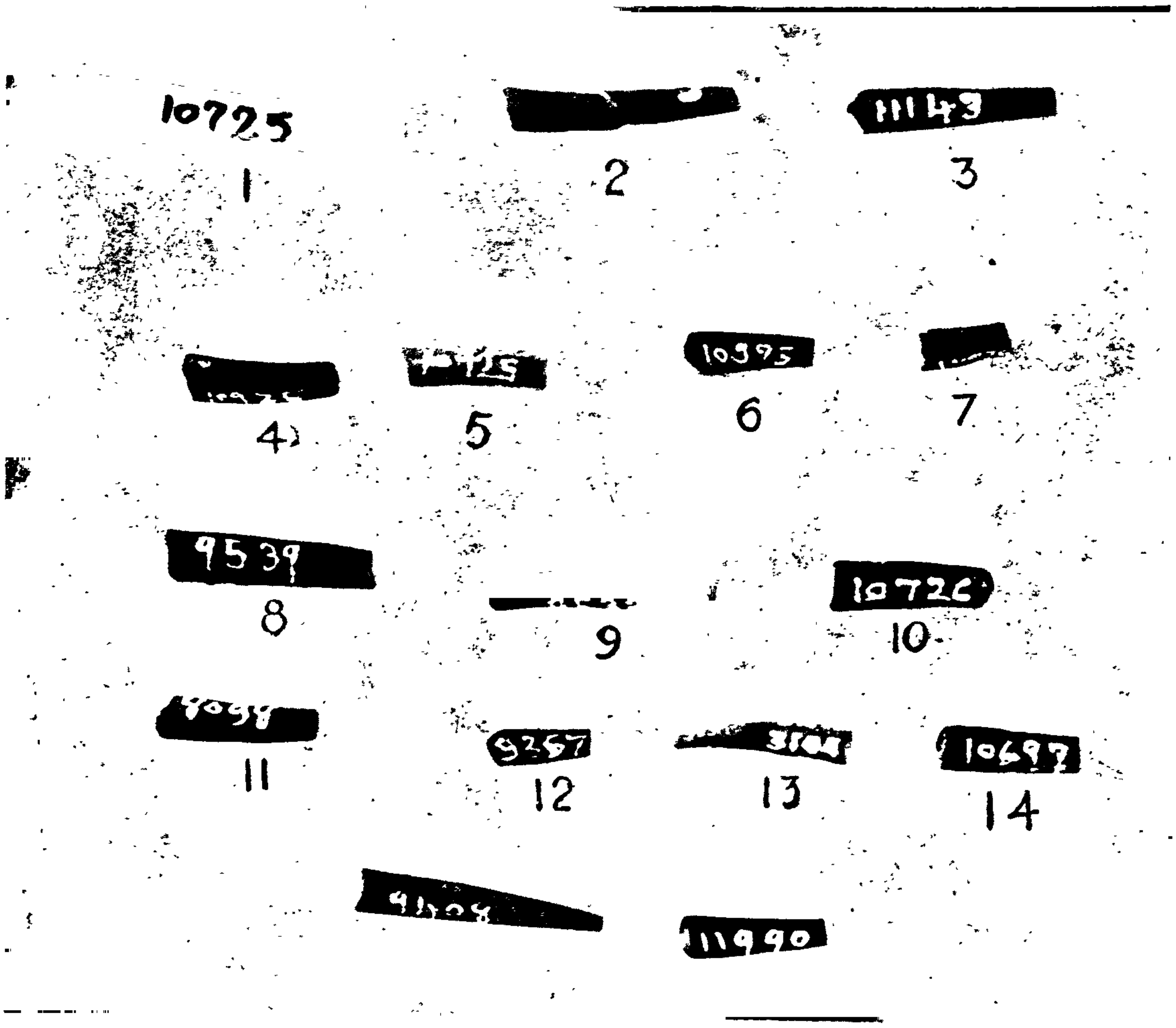
A and B. *1, 4, 8 and 11 Arca inequivalvis Brug; 2 and 9 Mactra cornea Desh; 3 and 10 Choine imbricata Sow.; 5 and 12 Cardium oxygonum Sow.; 6 and 13 Standella capillacea Desh. 7 and 14 Chama macrophylla Chem.* *See pp. 621 and 622*

A

B

C

A, *Valve pieces of Arc and venus shells*; B, *Xancus (Turbinella) Pyrum (Linn)*; C, *Fusus (Hemifusus) sp.* *See pp. 621 and 622*



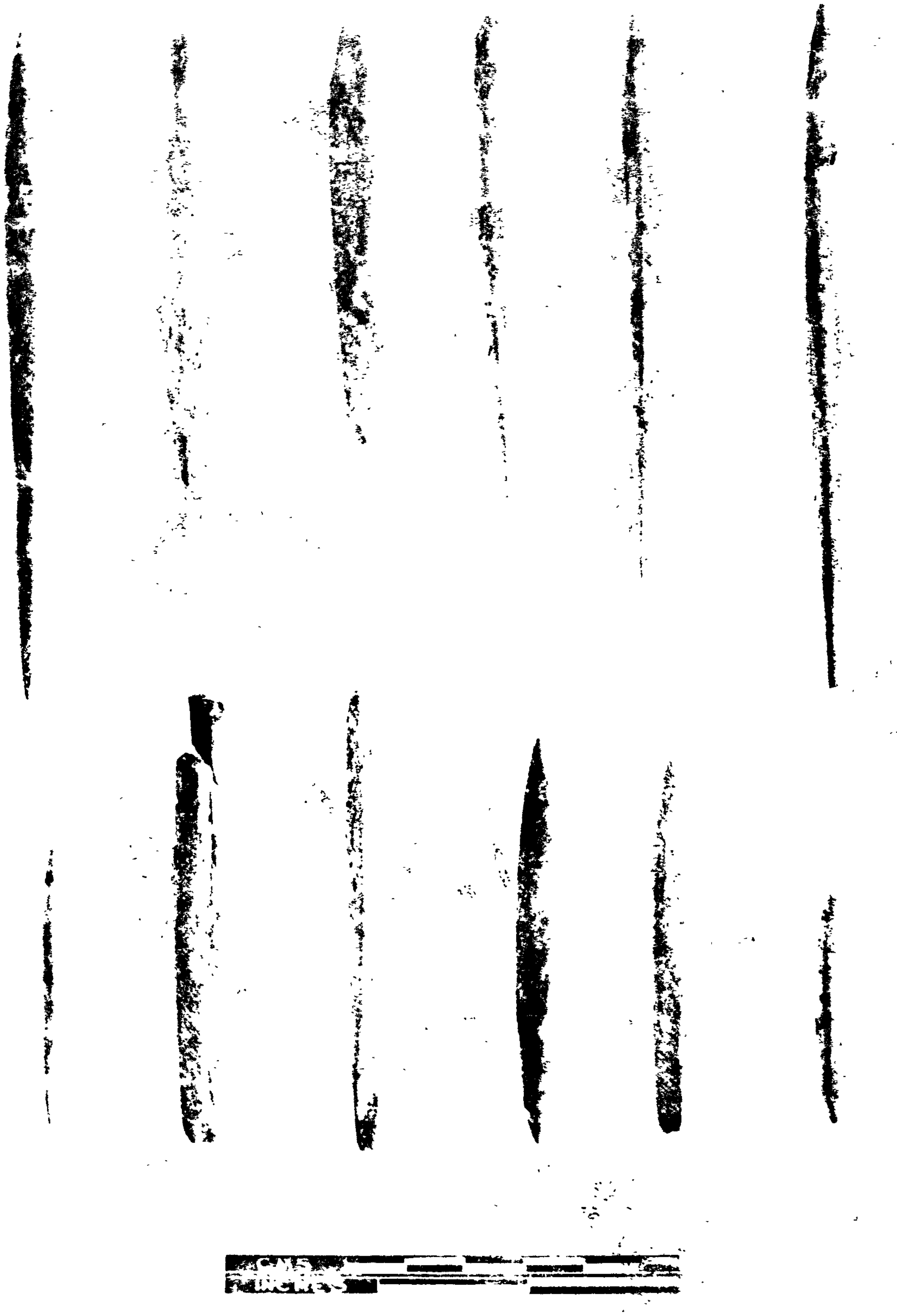
1-2 Dentalium sp.; 3-16 Dentallium octangulatum Donovan. *See p. 623*

1-5 Vivipara dissimilis (Muller); 6-8 Lymnaea (Gulnaria) pinguis (Dohrn). 9-13 Planorbis (Indoplanorbis) exustus Desh. 14-15 Lamellidens marginalis (Lam.); 16-18 Parreysia (Parreysia) corrugata (Muller). *See p. 623*

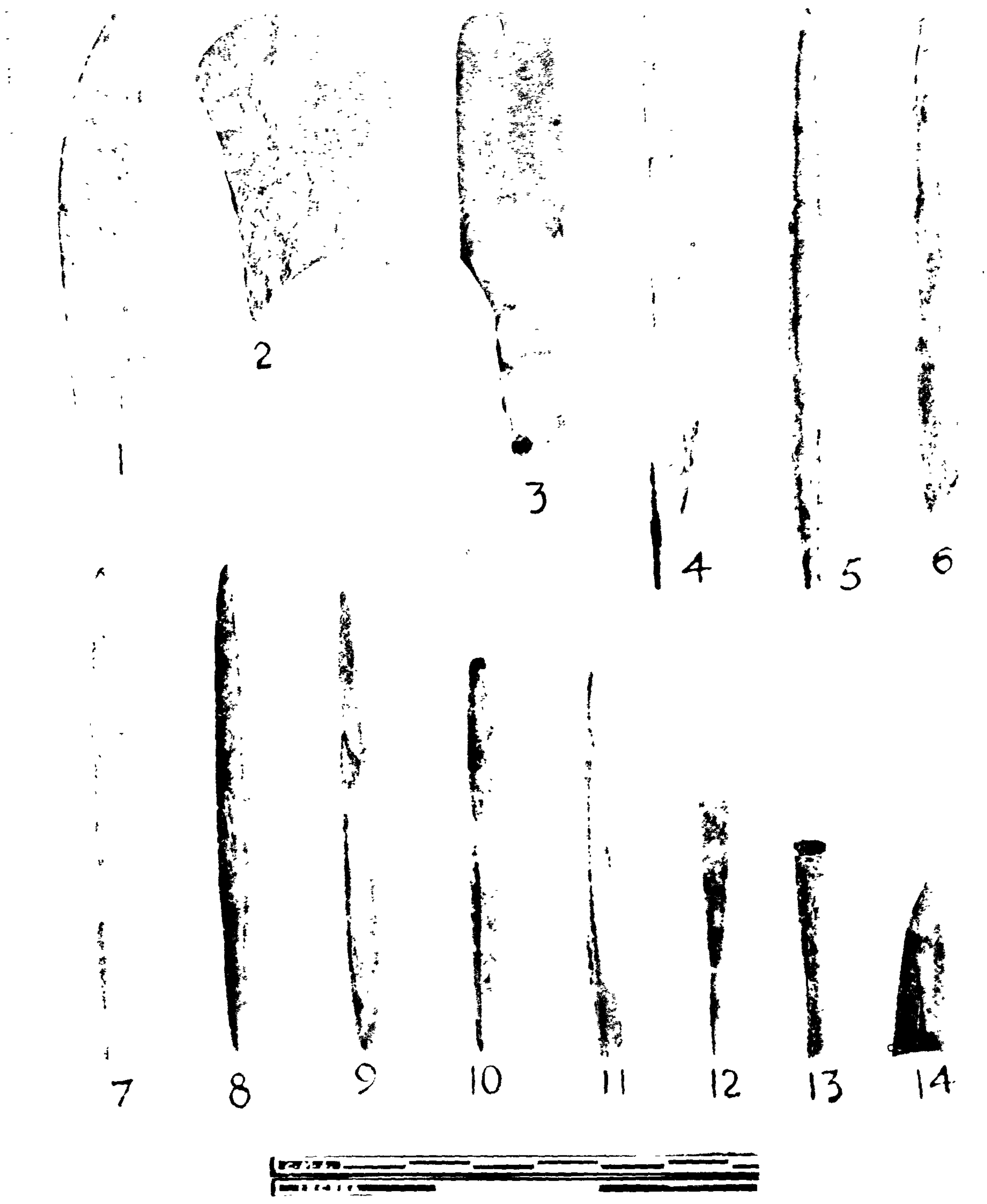
A

B

A, *Pila globosa (Swainson)*; B, *1-8 Valve-pieces of Lamellidens marginalis (Lam.)*; *9-19 Valve-pieces of Parreysia (Parreysia) corrugata (Muller)*. *See p. 623*

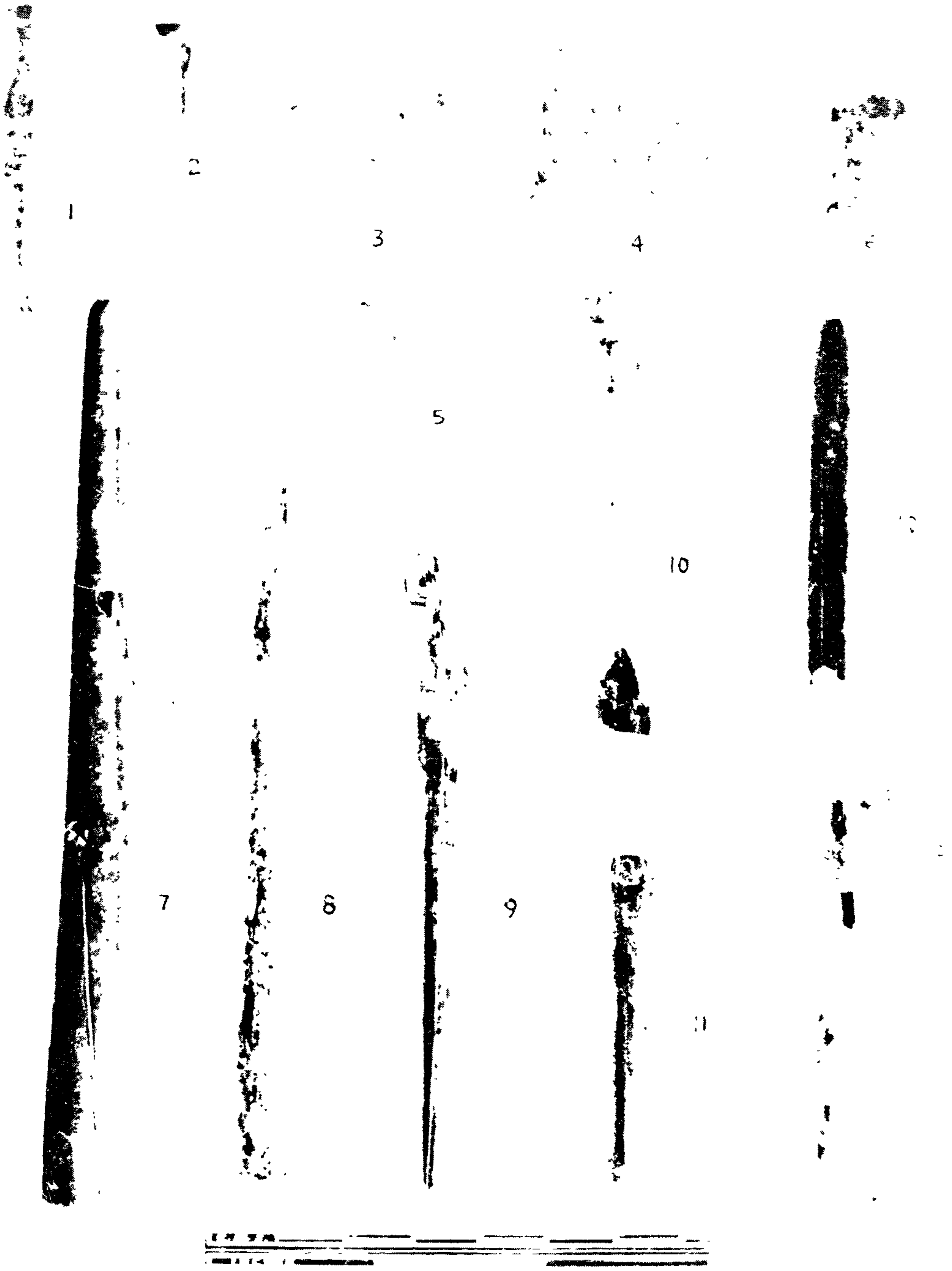


Bone objects, awls, scrapers, arrow-heads, engravers etc. See pp. 624 and 626



Ivory objects, 1-2 ceremonial knives, 3 ordinary knife, 4 ceremonial dagger, 5-6, 9-12 and 14, awls; 7, knitting needle, 13, kohl-rod. See pp. 628 and 630

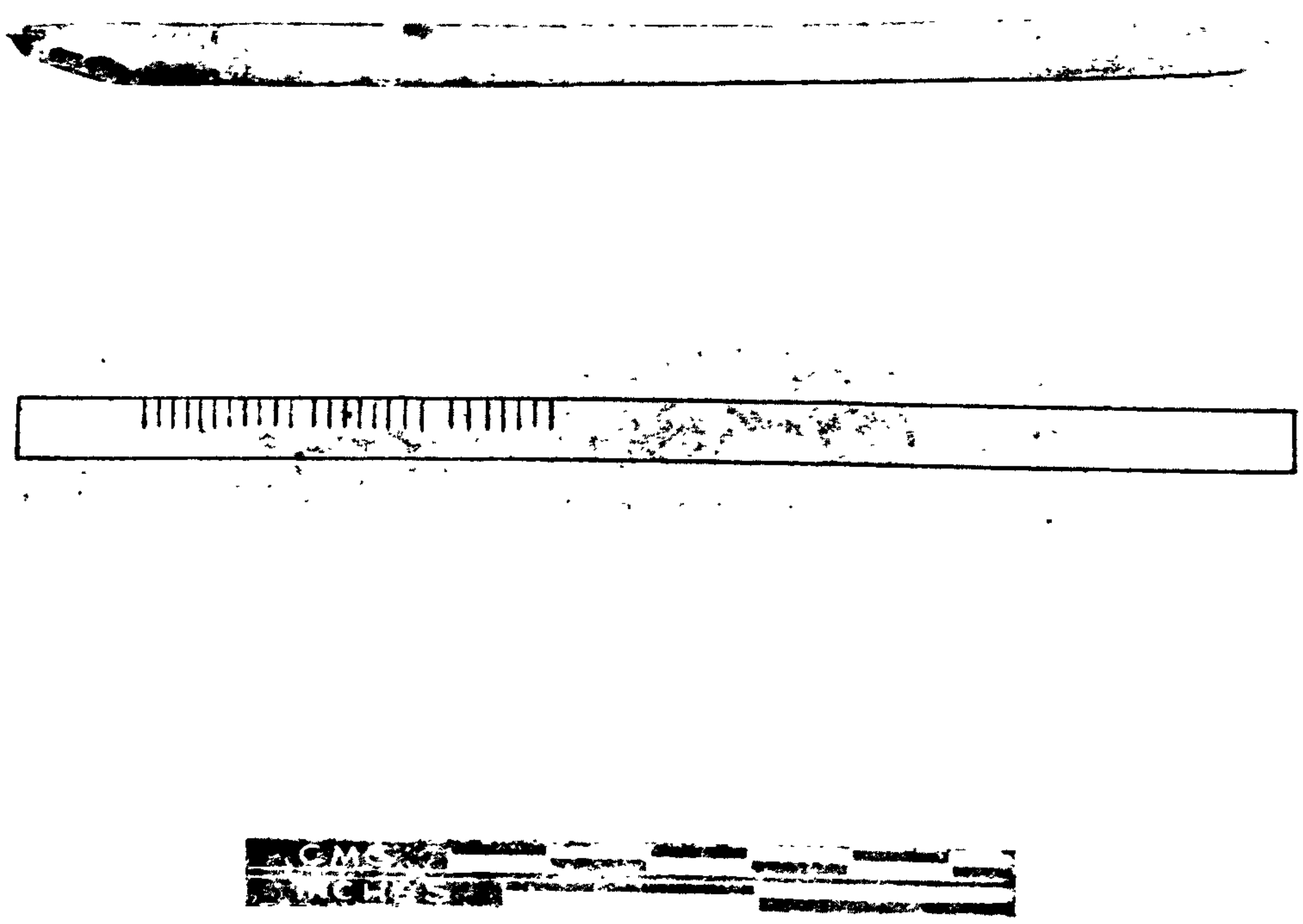
PLATE CCXCIII



Ivory objects. 1 hair pin; 2-3 ear-ornaments; 4 pendant; 5-6 gamesmen; 7-12 rods; 13 bottle-stopper; 14 tablet. See pp. 630 and 631.

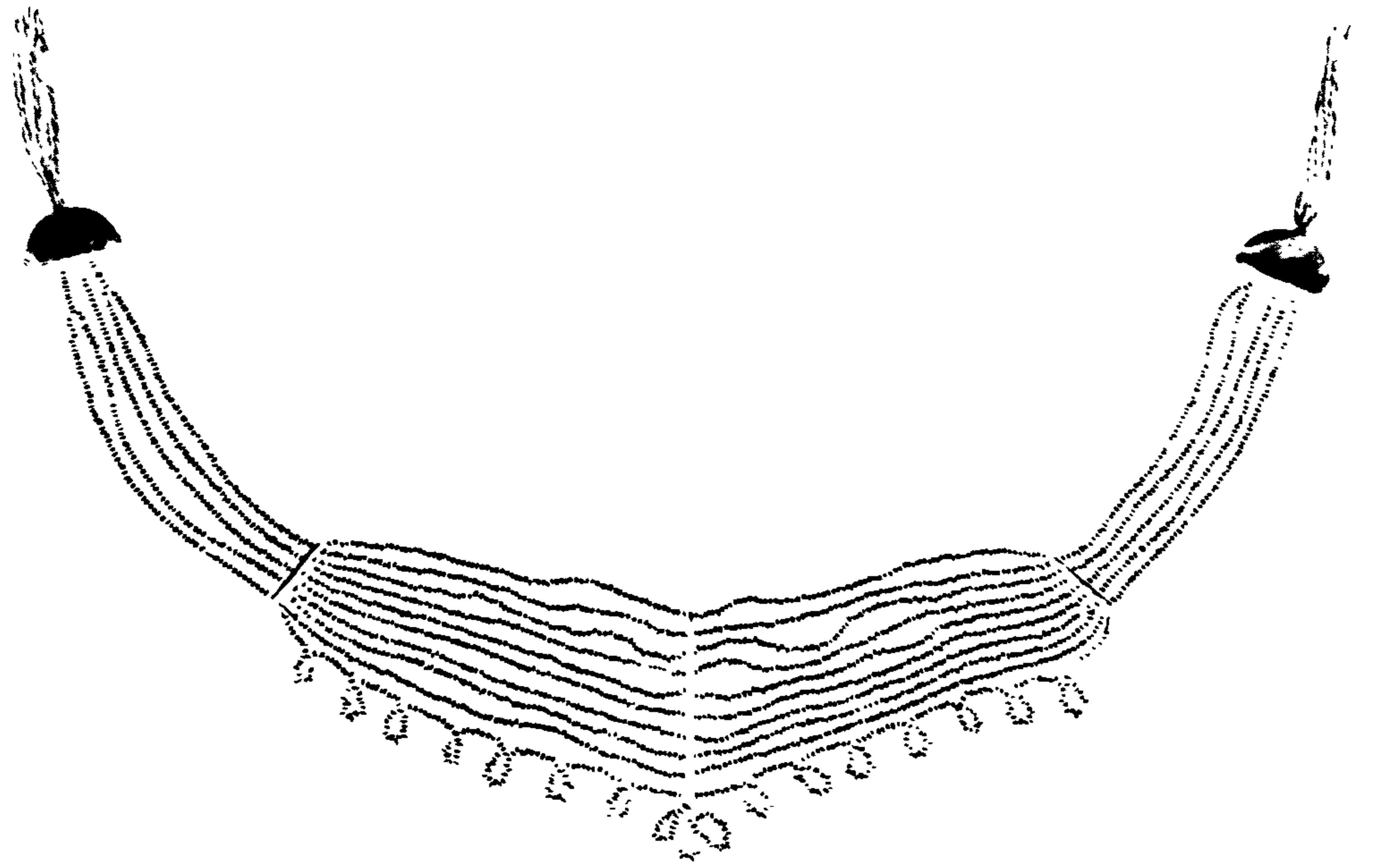
PLATE CCXCIV

A

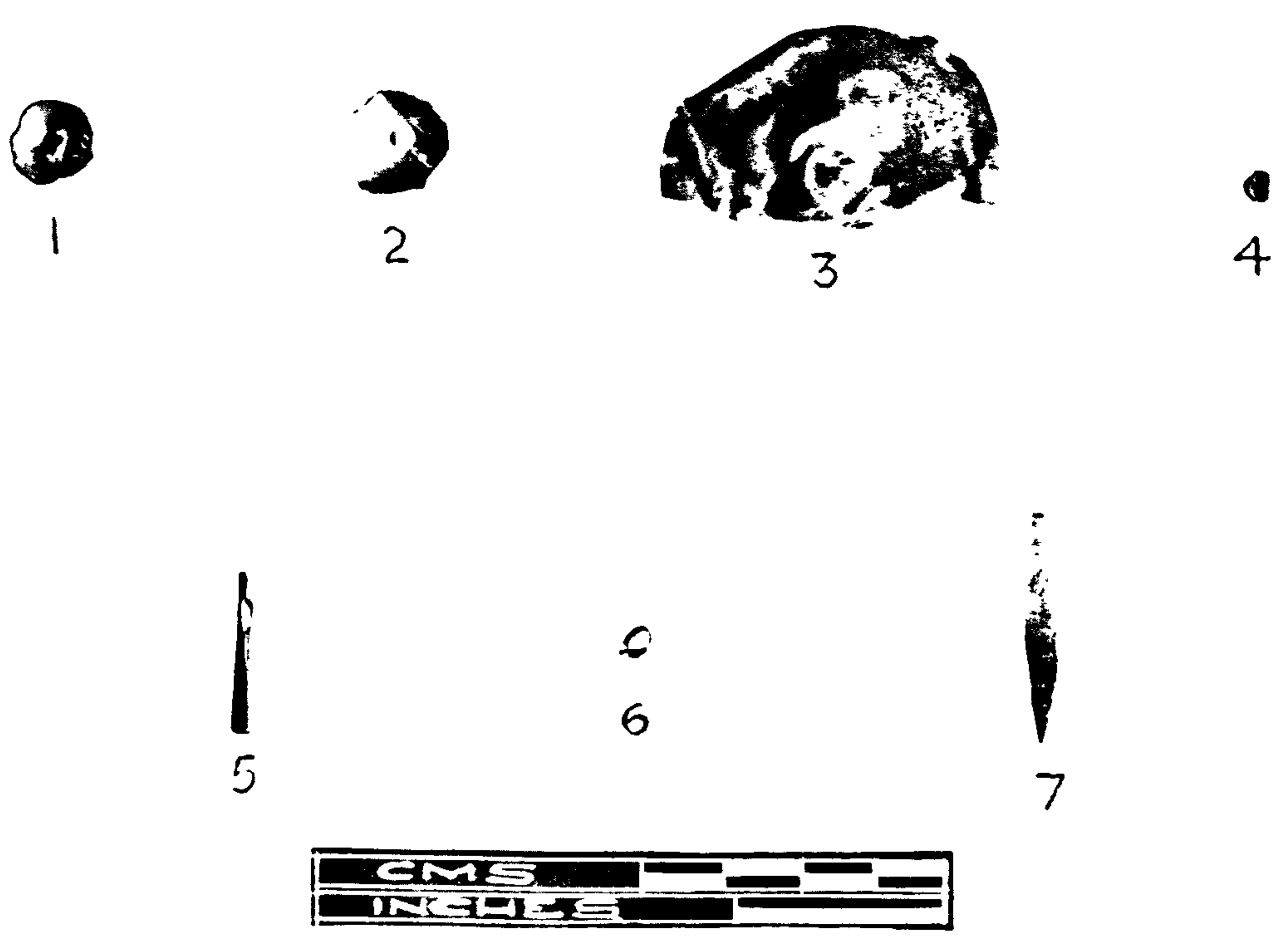


B

A, *Fragmentary ivory tusk*; B, *Graded ivory scale (top); Clearer lines marking divisions are shown below. See pp. 630 and 631.*



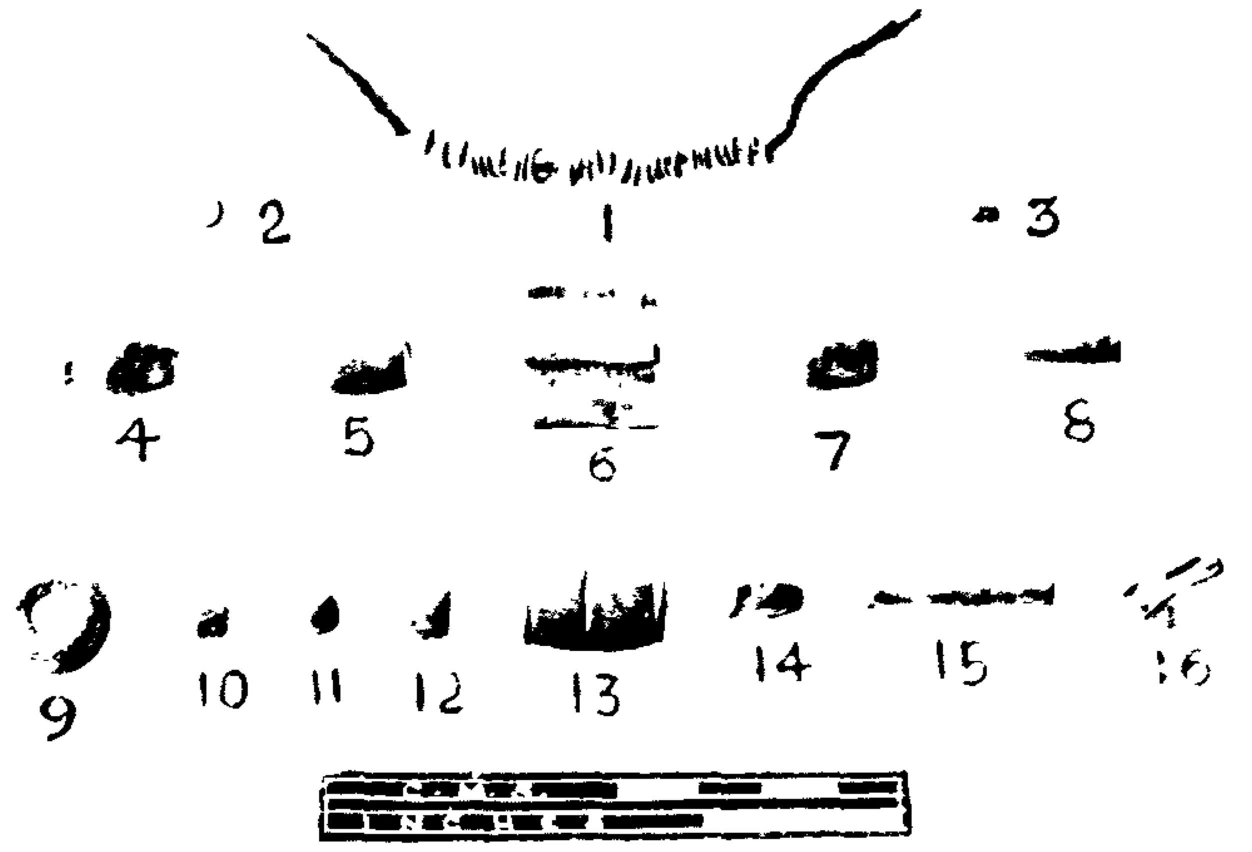
A



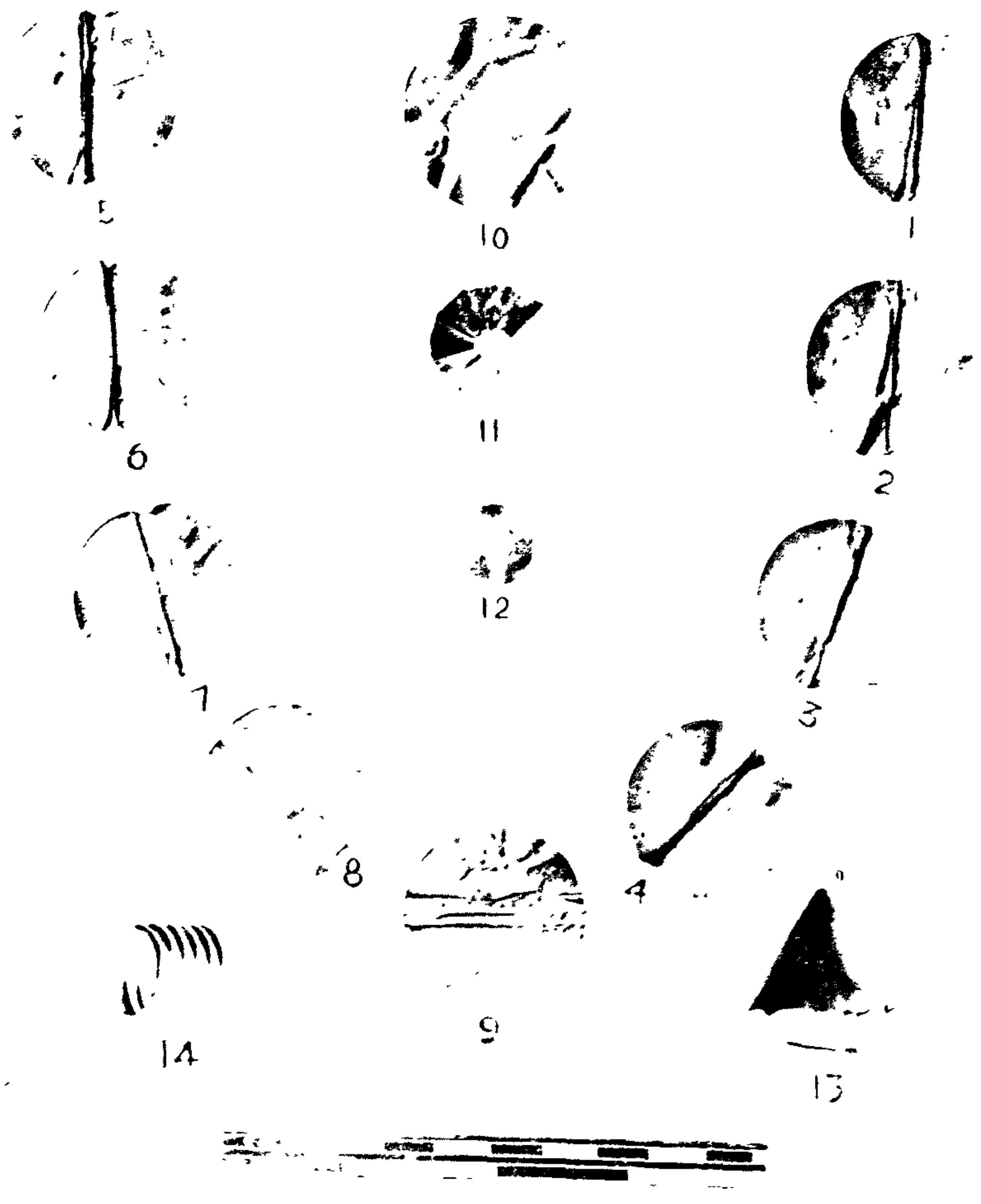
B

A, *Gold necklace of micro-bcads (reconstrueted), Scale 1/1;* B, *Gold objects, 1-5 ear-ornaments; 6 Beads; 7 inlay-piece. See pp. 633 and 634*

PLATE CCXCVI



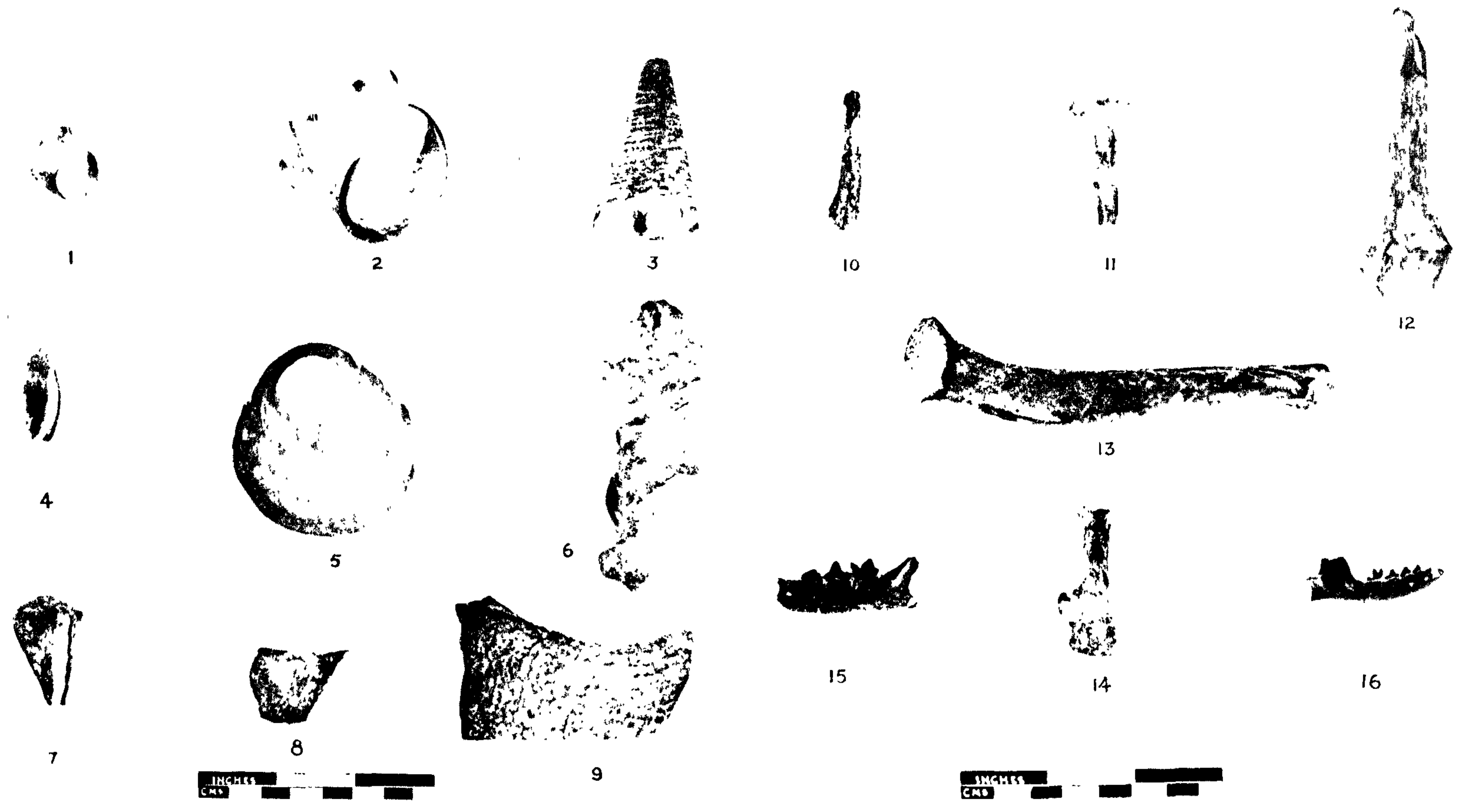
A



B

A, *1-12, 14-16 Gold beads, 13 Jasper bead revetted with gold boils on sides*; B, *Other gold ornaments, 1-9, beads; 10 pendant; 11 ear-ornament, 12-13 head-ornaments; 14 ring. See pp. 582, 633, 634 and 635*

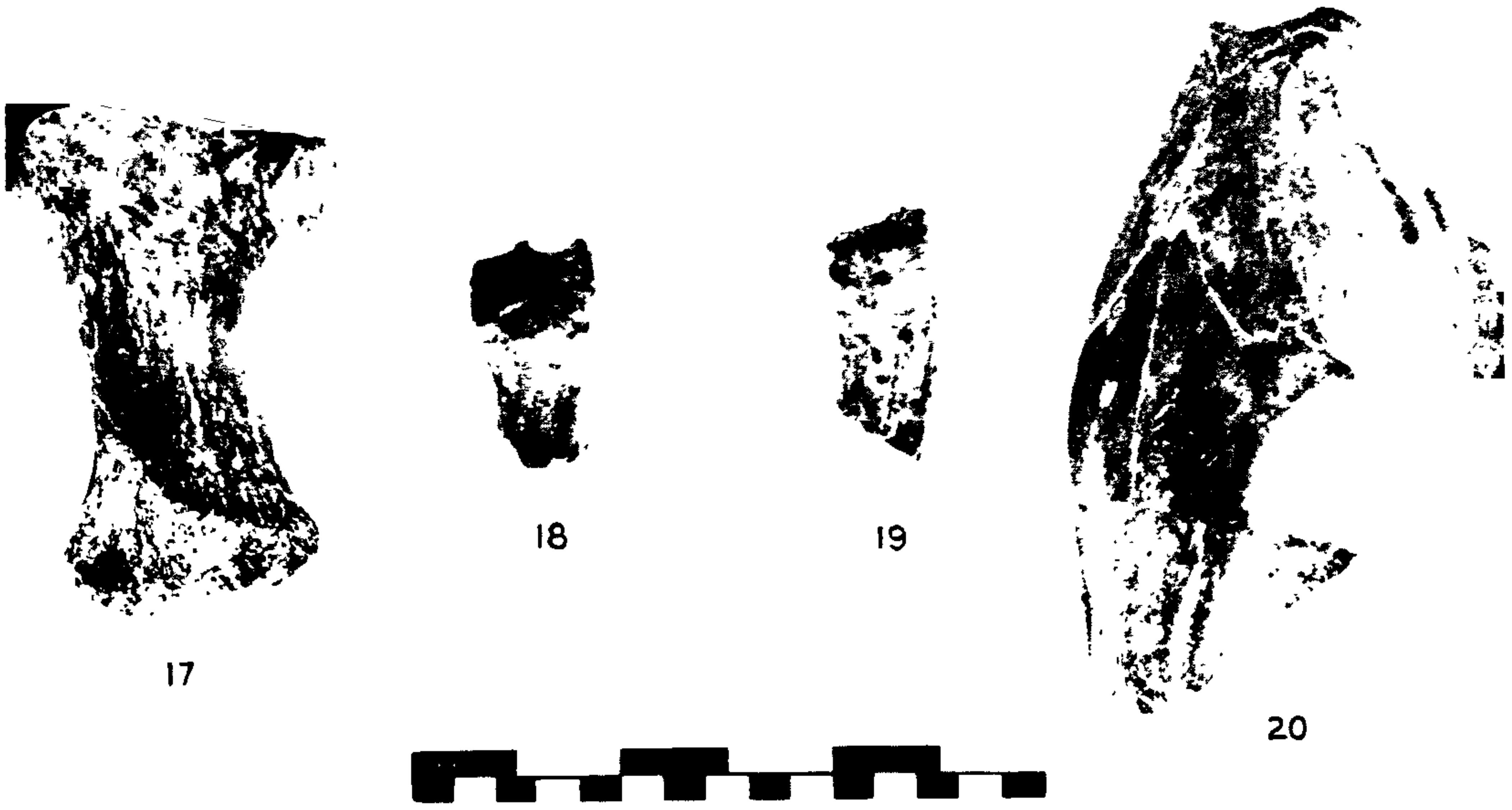
PLATE CCXCVII



A B

A, *Viviparus bengalensis (Lamarck)* race *mandilensis Kobalt Pila globosa (Swainson), Telescopium telescopium Linn., Olivta ispidula Lamarck, Xancus pyrum Linn., Conus (Rhizoconus) rattus Bruguiere Lissemys punctata (Bronnaterre) forma typica, Chitra Indica (Gray)*. B, *Gallus sp., Canis familiaris Linn., Canis aureus Linn., Herpestes Auropunctatus Nodgson. See pp. 638, 639, 640, 641, 648, and 649.*

PLATE CCXCVIII

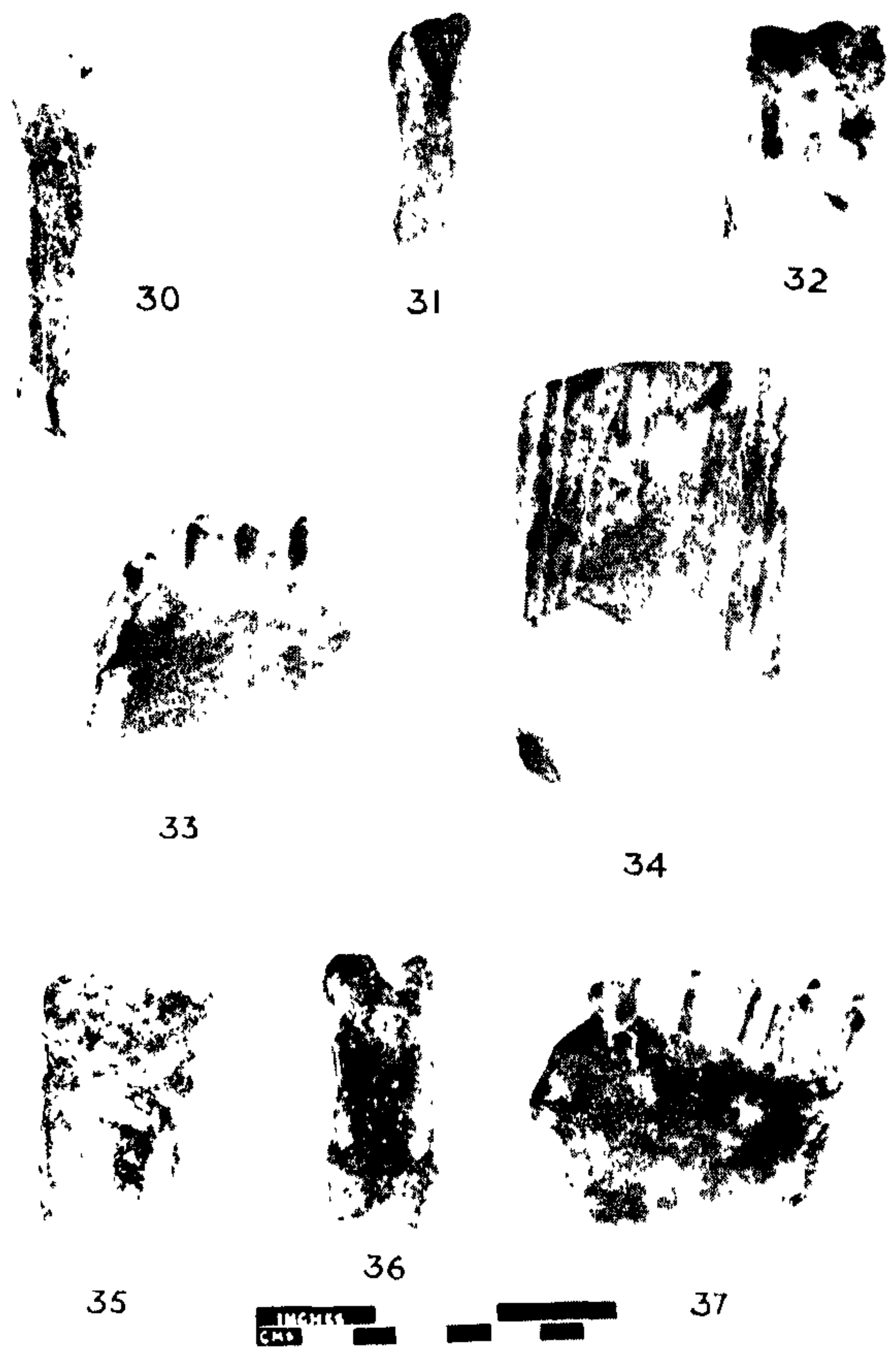


A

B

A, *Elephas maximus Linn. Equus caballus Linn. Sus scrofa cristatus Wagner* ;
B, *Rhinoceros unicornis Linn.* *See pp. 641, 642 and 649*

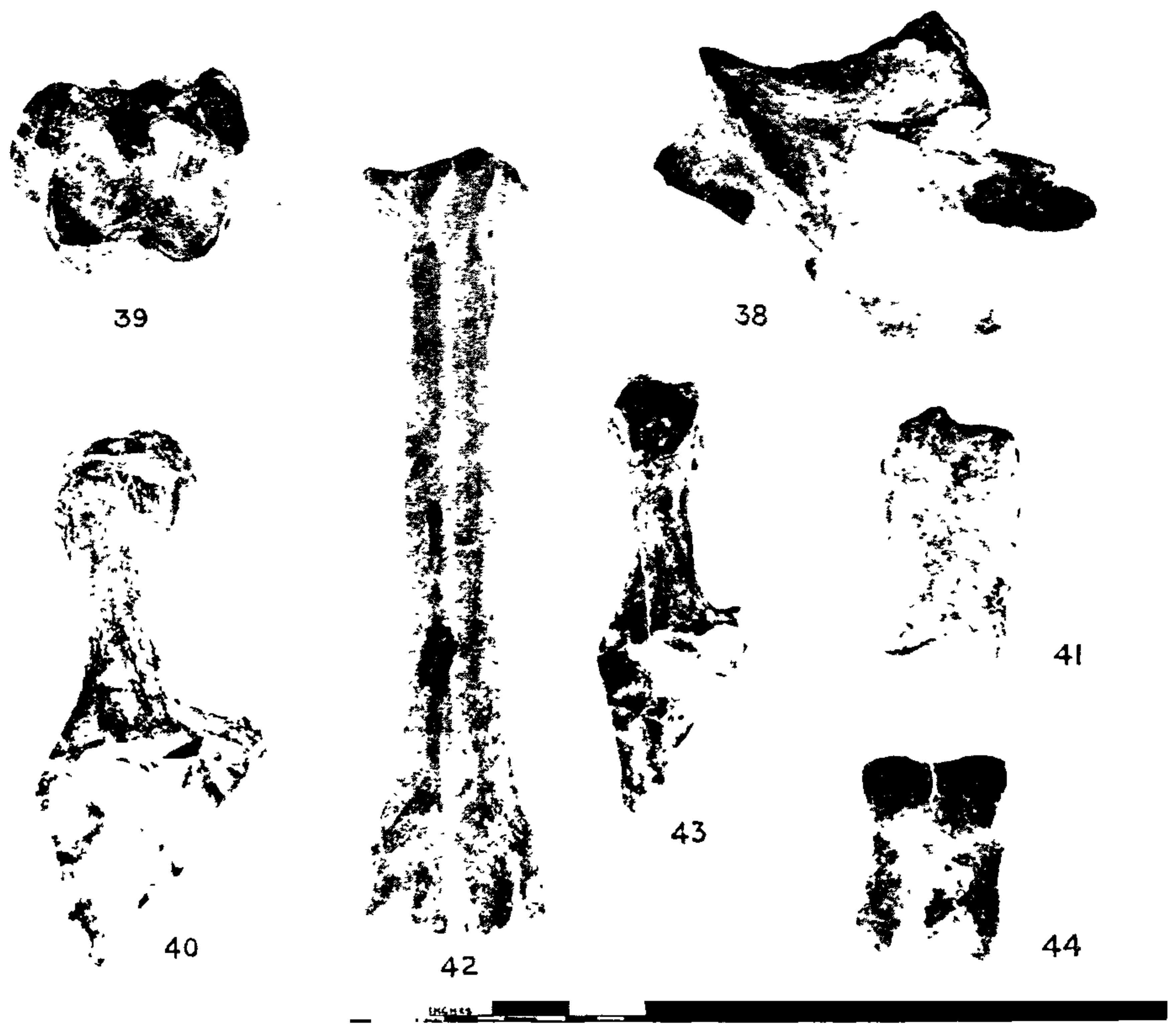
A



B

A, *Sus scrofa cristatus wagner*; B, *Muntiacus mumtzak Zimmermann, Axis axis Erxl. Cervus unicolor Kerr, Cervus duvauceli Cuvier, Boselaphus tragocamelus Pallas, Bos gaurus H. Smith.* *See pp. 642, 643, 644 and 649*

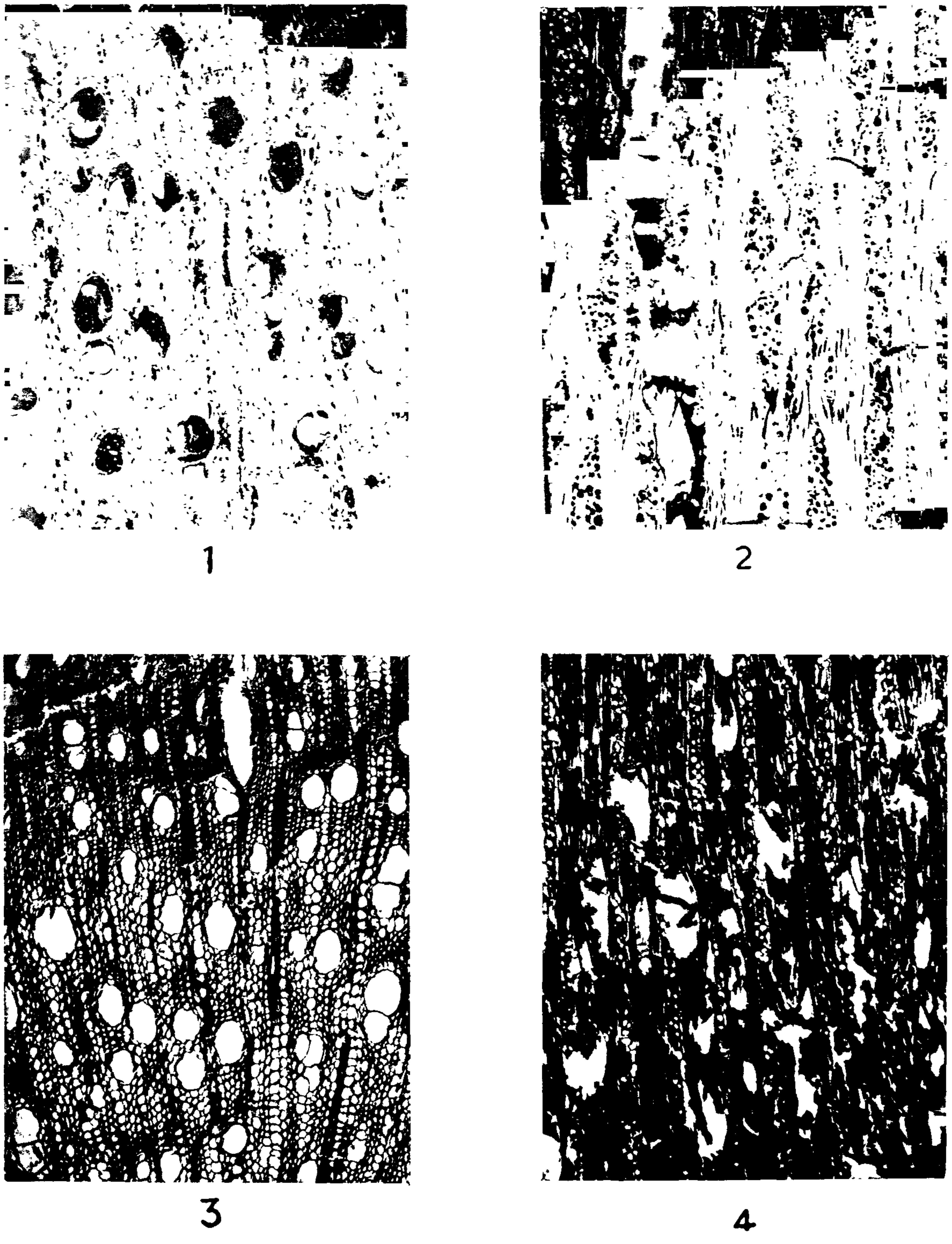
PLATE CCC



A

B

A. *Bos indicus Linn*: B. *Antelope cervicapra Linn*., *Capra hircus aegagrus Erxl*., *Ovis orientalis vignei Blyth*, *Lepus nigricollis Cuvier*. *See pp. 645, 646, 647 and 650*



1. *Transverse section of charcoal, Acacia Sp.* 2. *Trangential section of charcoal, Acacia Sp.* 3. *Transverse section of charcoal, Albizzia Sp.* 4. *Tangential section of charcoal, Albizzia Sp.* *See pp. 671 and 683*

1

2

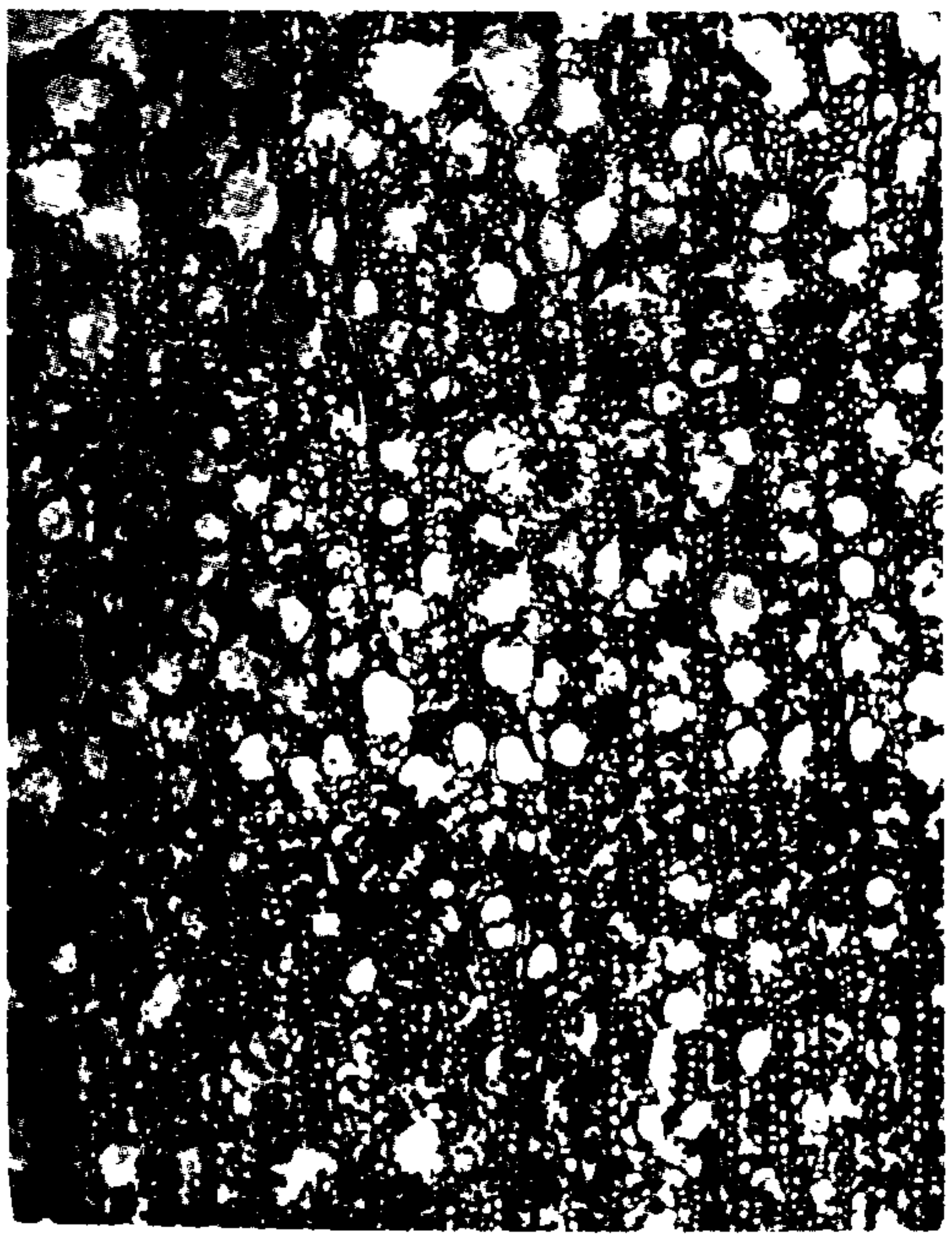
3

4

1 *Transverse section of charcoal, Tectona grandis Linn. f.* 2 *Tangential section of charcoal, Tectona grandis Linn. f.* 3 *Transverse section of charcoal, Adina cordifolia (Rosh) HK. f.* 4 *Tangential section of charcoal, Adime cordifolia (Rosb) Hk. f.* *See pp. 673, 683 and 684*

1

2

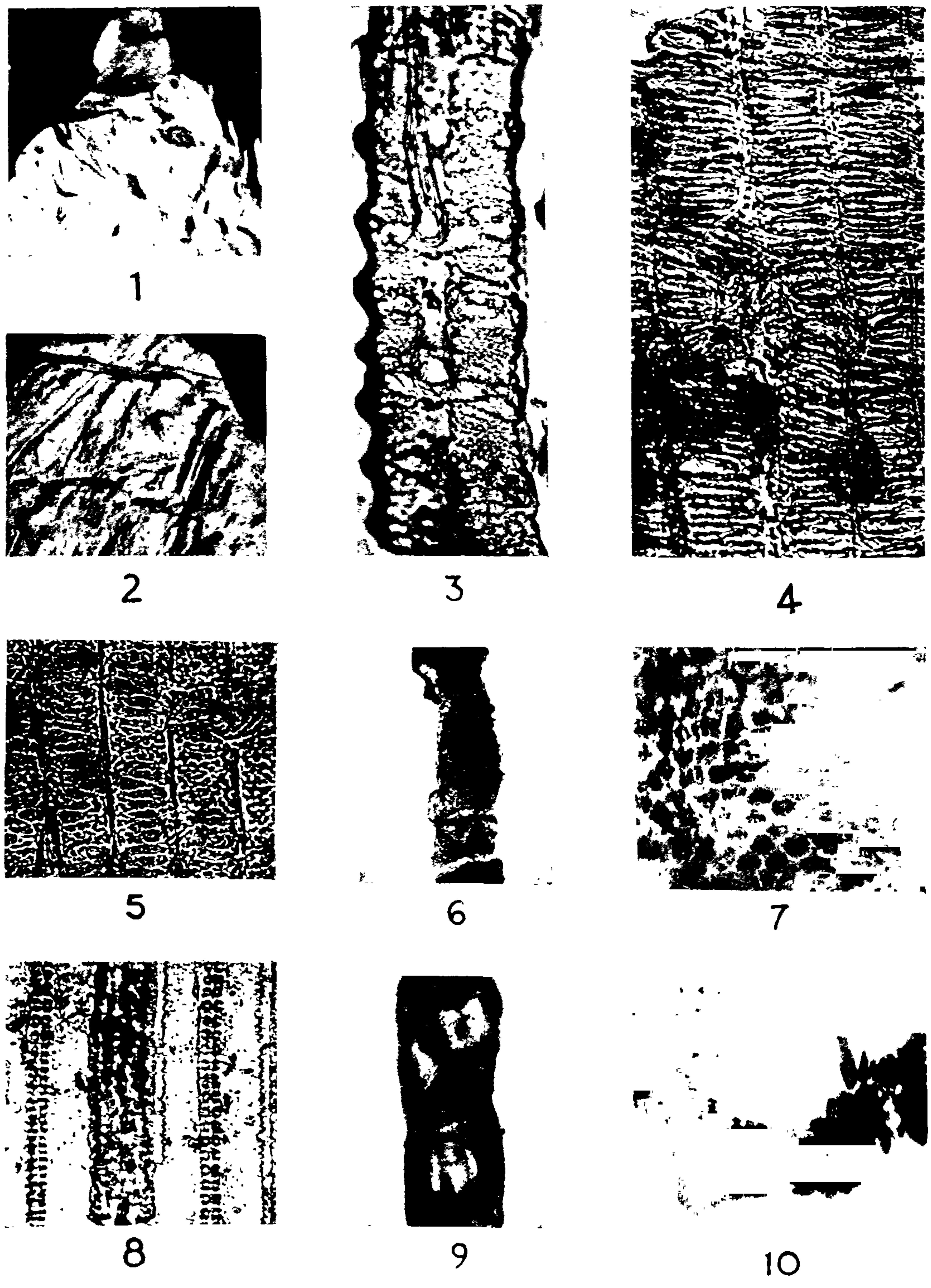


3

4

1 Transversesection of charcoal, Soymida feboifuge A. Juss. 2 Tangential section of charcoal, soymida feboifuga A. Juss. 3 Transverse section of charcoal, Lauraceous wood. 4 Tangential section of charcoal, Lauraceous wood. *See pp. 673, 676 and 684*

PLATE CCCIV



1-5 and 8, Oryza sp. 2, 6, 7, and 10 Calcined geam. *See pp. 676 and 684*

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